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Application of Arc Welding in Machinery Construction

Heavy Castings Damaged in Shop or in Operation Repaired with Speed by Welding Process—Forging Weld Increases Its Strength and Quality — Paper Before Society of Refrigerating Engineers

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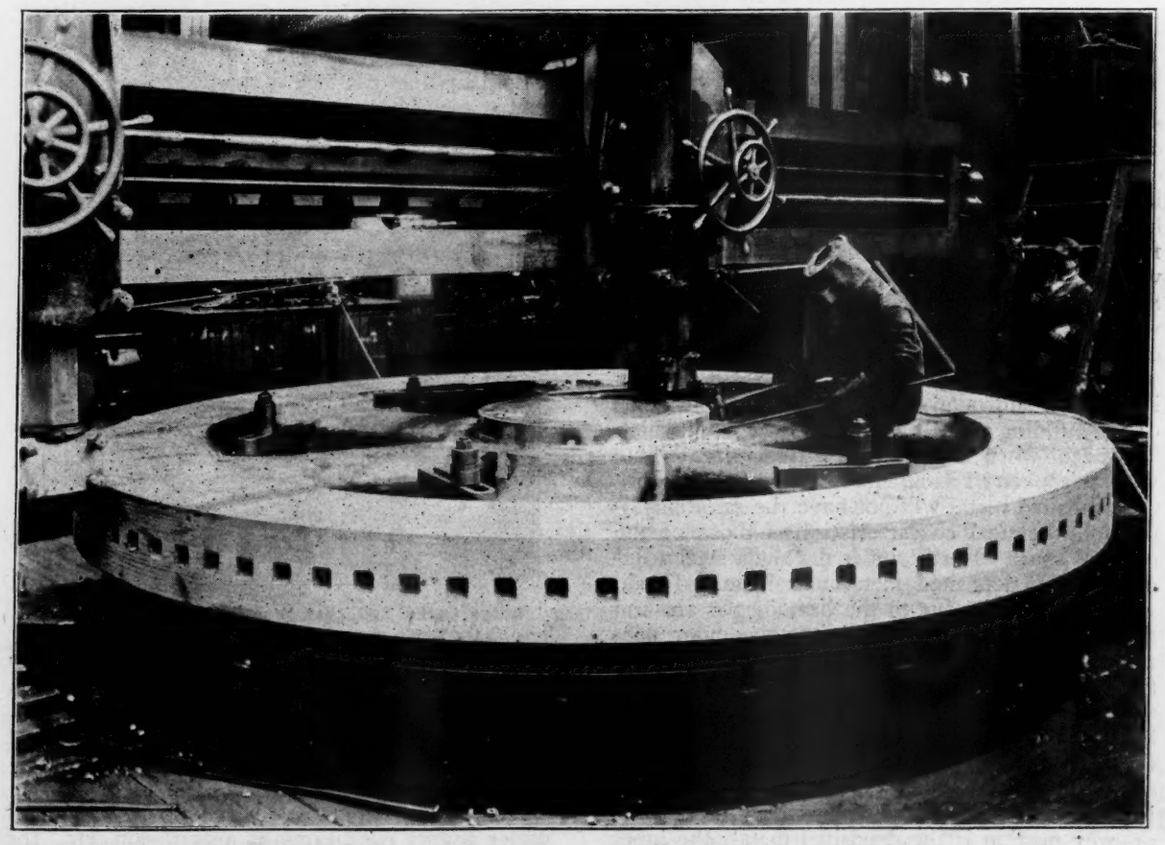
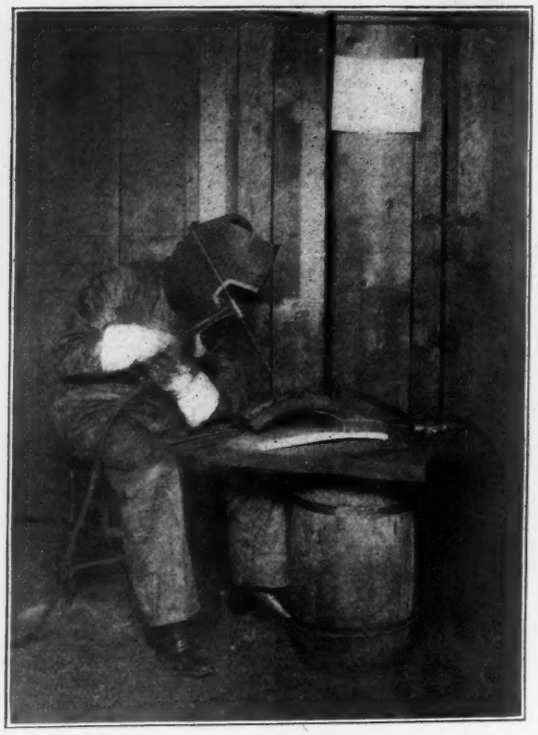
The process of arc welding is of vital economic interest to both the manufacturer and user of modern refrigerating apparatus. The manufacturer's interest is, in fact, dual because the process is not only a valuable adjunct to tools for repair of shop equipment, but also is a manufacturing process as well. It is to be admitted that arc welding has not been applied so extensively in this latter field as might be expected. There are at least three very good reasons for this condition —first, an insufficient supply of good trained operators; second, a lack of confidence in arc welded joints and characteristics of good arc deposited metal; and third, a relatively limited understanding of the proper methods of arc welding process control and methods of visual inspection which permit of commercially accurate evaluation of arc welded joints.

It is intended therefore to point out how arc welding apparatus can be used to advantage for repairing a large variety of defective or accidentally damaged shop machinery and also to deal



Repairing a Large Flywheel Casting by Electric Welding Process.



Welding Operator Provided With Modern Protective Devices.

with some of the underlying fundamental welding principles, with a view of stimulating the manufacturers to use the arc welding process more extensively in manufacturing operations where it can be economically and safely applied.

The field of repair work is almost unlimited, and therefore only a few of the more representative applications will be given. Large castings such as flywheels for various types of compressors which develop defects during manufacture or operation can usually be repaired quickly and economically, as indicated in an accompanying illustration. Another illustration shows a large lathe bed which was broken when being transferred from one shop to another. This lathe bed was successfully welded and the alignment when finished was out less than 1/32 in. The joint was reinforced by a steel plate which made it sufficiently strong to withstand being lifted at the center by chains swung from a crane. Still another illustration shows an emergency repair consisting of the building up of the journal of a shaft which has been worn or machined undersize. This work is spoken of as an emergency repair because the deposited metal will not have the same physical and chemical characteristics as those of the original shaft. Furthermore the shaft steel adjacent to the deposited metal will have its grain structure altered, due to the heat of the arc and the deposited metal which raises the outer portion of the shaft steel above its critical temperature after which this steel is rapidly cooled (practically quenched) due to rapid heat flow into body of shaft and due to radiation to air through the deposited metal. This shaft was polished and etched with a 10% solution of nitric acid so as to identify the portions as follows: Outer white or grey portion is the deposited metal; the inner black scallops are the hardened areas of the original shaft and the innermost dark grey area is that portion of the shaft steel which has been unaffected by the welding operation.

Composition of Wire Altered in Process of Welding.

By properly heat treating the shaft after welding the hardened area can be reduced to its original state. However, no amount of the heat treatment will materially affect the arc deposited metal which is very low in carbon and manganese, although an appreciable percentage of each was present in the welding wire. The difference between the two is given in the accompaning table:

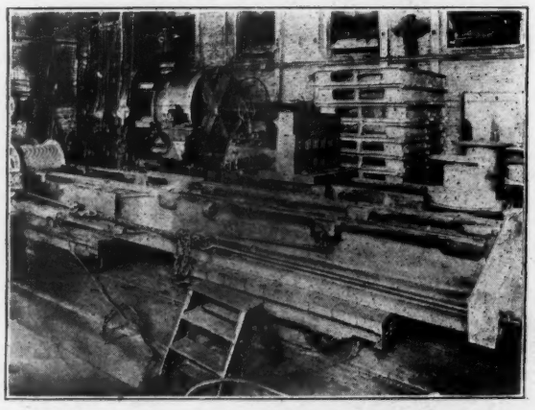
TABLE SHOWING DIFFERENCE IN WELDING WIRE BEFORE AND AFTER BEING DEPOSITED.

	Carbon.	Manganese.	Phosphorous.	Sulphur.	Silicon.
Welding wire, original	0.16	0.56	0.032	0.024	0.016
Welding wire, deposit	0.05	0.18	0.031	0.036	0.011

It must be manifestly evident, therefore, that we should not expect the welded shaft to have all the desirable mechanical properties of a new unwelded shaft.

In the manufacture of a boring-mill spindle the tapered end was machined too large for the tool arbor to be used in it. This tapered hole was about 3.5 in. diam. and 9 in. deep, which made a rather difficult welding job for the operator. The finished job was entirely satisfactory and the finished bore was reduced to about 3.25 in. diam., only one layer of arc deposited metal being necessary to secure the results.

In the manufacturing field the writer believes that the equipment manufacturers have hesitated to employ arc welding for equipment subjected to alternating stresses such as pressure vessels of various types. This hesitancy has probably been principally due to a lack of knowledge of arc deposited metal characteristics, proper methods and procedure to obtain and assure these desirable characteristics, and, finally, the fact that fusion



Large Lathe Bed That Was Repaired by Welding.

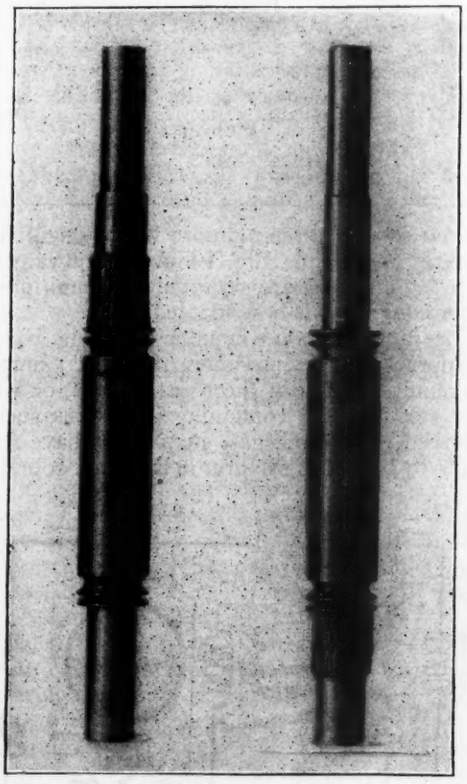
welding is not recognized or rated by the Boiler Code Committee of the American Society of Mechanical Engineers and similar organizations.

Success of Arc Welding Amply Demonstrated in Actual Practice.

That arc welding has been successfully used under proper conditions of supervision, etc., for structures designed to carry live loads involving shocks, alternating stresses and vibratory stresses

is illustrated by the case of the all-welded coasting vessel *Fullagar* built by Cammell, Laird & Co., Ltd., Birkenhead, England. This vessel has been in service since June 28, 1920. The principle data is as follows: Length B. P., 150 ft.; breadth, moulded, 23 ft. 9 ins.; depth, moulded to main deck, 11 ft. 6 ins.; depth to raised quarter deck, 15 ft. 6 ins.; load draft, 11 ft. 4 ins.; load deadweight, about 500 tons; cargo capacity, about 25,000 cu. ft., and speed, 9.5 knots. This vessel including the shell plating is reported to be entirely welded, no rivets being used in the construction.

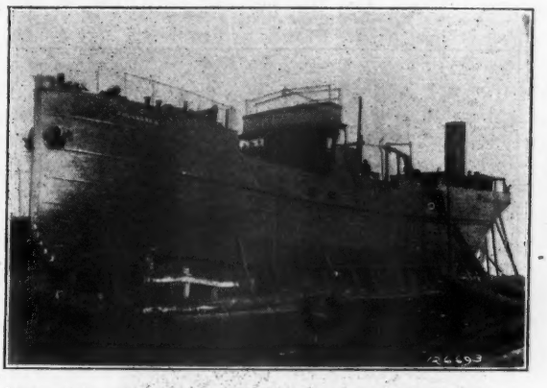
In another case a small mill building 40 ft. by 60 ft., having four 40-ft. roof trusses supported on 8-in. H-beam columns fitted with brackets for a 5-ton traveling crane, was erected by means of the welding process. All material was received on the job cut to length and assembled by arc welding in March, 1920. Before erection two trusses were set up and tested by loading to 48 tons with bags of gravel for 48 hrs., at the end of which time the load was removed and the only permanent deflection which could be observed was 1/16 in. at the center of the bottom cord. The report of the building inspector states: "From the above tests it is evident that electric welding is a dependable method of uniting structural members and is stiffer than riveting, if the work is properly performed." The roof trusses were built for a price



Typical Example of Repair Work on Worn or Undersize Shaft.

of $24 each, whereas the nearest estimated shop cost for a riveted truss was $25.

One of the large manufacturers of refrigerating machinery has been investigating the application of arc welding for ammonia receivers. In the course of this investigation four such tanks of 5/16-in. thick steel, approximately 16 in. diam. and 6 ft. long, complete with all fittings, were welded by various operators. To test these tanks each was subjected to the following procedure: Each tank was placed on a rigid foundation with the longitudinal seam uppermost. A 10-lb. weight was dropped a distance of 10 ft. so that it struck the longitudinal seam at five different points;



Steamship "Fullagar" Fabricated by Welding Process.

namely, both ends, the center, and two points between the center and ends. Each tank was then subjected to 350% hydraulic pressure followed by 500 lbs. of air pressure without developing any distress. The tanks were then tested to destruction by hydraulic pressure, failing at values indicated in the accompanying table.

TABLE SHOWING TESTS TO DESTRUCTION OF WELDED TANKS.

Tank No.	Rupturing pressure in lbs.	Plate fibre stress, lbs. per sq. in.
1	1350	43,000
2	1400	44,800
3	1500	48,000
4	2200	70,400

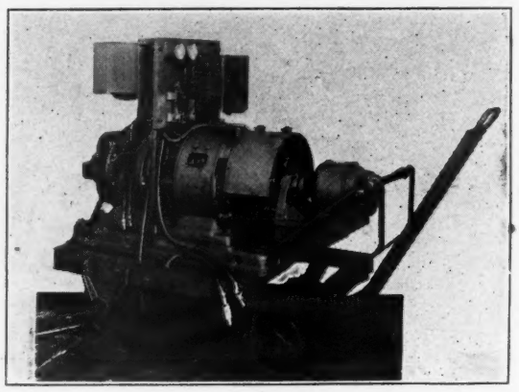
In the case of the fourth tank the welding work undoubtedly had been performed very carefully, observing the correct procedure, because before the side seam failed the head bulged out very appreciably. When failure did occur the strains were pronounced, as indicated by the flaring of the shell plate opening up approximately 2 ft. along the longitudinal seam and about 10 ins. along the girth seam at the head. It is conceivable that if the welded seams could be subjected to forging, as will be pointed out later, that the results could have been materially improved. If every manufacturer of refrigerating machinery would do similar experimental and development work it is believed that arc welding would be economically employed much more extensively in the refrigeration field.

To determine the characteristics of arc deposited metal when put down, observing the fundamental principles such as proper polarity, correct current value, correct size and type of welding wire, maintenance of short arc, etc., a considerable amount of research work has been done. To reveal the ductility of the arc metal large deposits were built up on steel plates, and test specimens were prepared from those. Some of the test results are given in accompanying tables.

An investigation was made to determine the effect of heating arc deposited metal to the proper temperature and then forging the deposited metal under the steam hammer. Samples of blocks were cut out both before and after forging from

which 5-in. test pieces were turned. The test data is shown in an accompanying table.

It is interesting to note that the proper forging not only increased the strength of the metal from that of a medium good weld to that of a very good weld, but also improved the ductility to a marked degree, the percent elongation being increased 500% and the percent reduction in area



Inherently Regulating Single-Operator Electric Welding Set.

being increased 423%. It would be highly interesting to see what results could be obtained by forging the arc welded longitudinal seam of an ammonia receiving tank and welding the heads in such a manner that the head seam is under compression rather than tension.

Description of Modern Arc-Welding Generator Set.

For the benefit of those who are not familiar with arc welding apparatus the following brief discussion of the principal equipment is given. An accompanying illustration shows the latest Westinghouse type of inherently regulating single-operator welding set which, as the name implies, is designed for supplying current for one operator only at a constant value maintained inherently by generator and excitation-circuit design without necessitating the use of resistance in the welding circuit. This generator with its exciter are designed so that for any given setting of the field rheostat the current through the arc will be maintained reasonably constant over the maximum arc-voltage range permissible in good welding practice; namely, from short-circuit to a maximum of 22 volts. It is to be observed that the short-circuit or zero-voltage current is practically the same as at the welding voltage value (20 volts), especially when set for current values of 150 amperes and below. The entire range of current values from 50 to 225 amperes is obtained in 21 steps of less than 10 amperes per step by adjusting only one device; namely, the field rheostat.

All of these desirable characteristics are obtained by the unique inherently automatic control system, shown in the accompanying diagram, wherein the 125-volt constant potential exciter is connected to the variable-voltage generator through fixed field resistors *R* 1 and *R* 2 in such a relation that under short-circuit current from the exciter flows through *R* 1 and the welding circuit and through the reversing field circuit so that it assists the series field in "bucking down" the separate field excitation, thereby materially reducing the short-circuit current. When the operator breaks the short-circuit by withdrawing his electrode from his work he interrupts this exciter current which forms a small pilot arc during the short time interval required for the generator to build up its voltage. This particular feature is of decided assistance to the operator in striking his arc. Under open-circuit or normal welding conditions (generator voltage 60 to 20 volts) the reversing field is excited in the opposite direction by current from the generator terminals, under which condition it assists the separately excited field and opposes the series field. In other words, under these conditions the reversing field is operating in the generator as a self-excited winding. It is due to all of these characteristics that only a very small external reactor (inductance) is required in the welding circuit. In fact, for current values of 135 amperes and above many operators prefer to use the machine with the reactor disconnected from the circuit.

Multiple-Operator Machines Where Much Work Is Done in a Small Space.

This equipment is best adapted for installations where portable apparatus is required or where the welding work is scattered over large areas. For installations where a large amount of work is centralized so that three or more welders will work close together, especially if low current values of 25 to 75 amperes are required, the multiple-operator equipment is best adapted.

TABLE SHOWING RESULT OF FORGING ON STRENGTH OF ELECTRICALLY WELDED JOINTS.

Joint.	Ultimate tensile strength	Yield point	Elastic limit	Elongation	Reduction in area
		Lbs. per sq. in.		%	%
Unforged	24,187	29,125	22,125	4.6	11.4
Forged	56,900	31,600	28,000	27.6	29.5

For multi-operator metallic-electrode welding circuits where current values of 75 to 25 amperes are required for thin sheet-metal work, or where poor steel is used containing impurities such as absorbed grease, oil, gas, etc., which have a tendency to blow out the arc, it has been found advisable to connect a reactor in the circuit in addition to the resistance to help stabilize the arc and minimize the effect of the unstabilizing influences just mentioned.

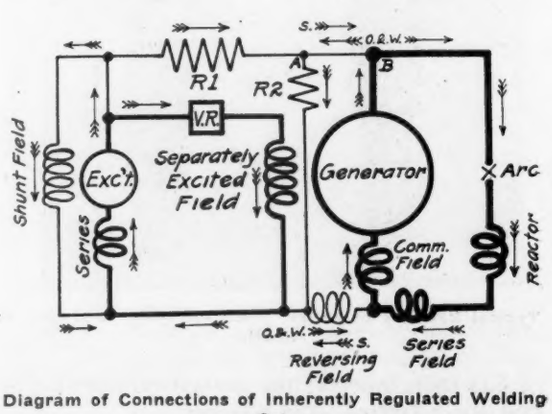


Diagram of Connections of Inherently Regulated Welding Set.

In an accompanying illustration an operator is shown in position for welding, his head, face and eyes being protected by a hood, his hands and wrists by gauntlets, and his body by closely woven union overalls. The hood is fitted with suitably designed glass which will absorb practically all of the infra-red and ultra-violet rays, which are very abundant in the electric arc and which will cause serious injury to the skin and tissue of the body if not guarded against. This same illustration also shows the necessary tools, including the electrode holder, a hammer, cold chisel and wire brush for cleaning each string of deposited metal.

TABLE SHOWING VARIOUS PROPERTIES OF ARC-DEPOSITED METAL.

Deposit.	Ultimate tensile strength	Yield point	Elastic limit	Elongation	Reduction in area
		Lbs. per sq. in.		%	%
A	56,100	33,400	27,500	18.1	30.8
	56,075	35,875	29,000	16.0	23.4
	58,225			18.0	27.8
B	51,375	29,050	24,000	14.1	18.8
C	40,875	29,400	24,250	4.4	15.9
	43,500	28,900	20,000	4.9	7.0

When it is desirable to do light graphite-electrode welding or cutting with the metallic electrode holder an adapter can be used.

In conclusion it is desired to point out that if the manufacturers of machinery will individually make an honest endeavor to develop the arc welding process by actual experimentation in their plants, following all of the data and principles briefly mentioned in this article, and fully covered in various other articles, arc welding will be economically and effectively applied in many operations where it is now thought to be impractical.

EUROPE MAKING BIG STRIDES IN PUBLIC UTILITIES.

Investigation of European Communicating Systems by Western Electric Co. Shows Progress Made in Electrical Development.

All the countries of Europe are preparing to improve their public utilities, according to J. H. Bell, a member of the engineering force of the Western Electric Co., who has just returned from a 9-mo. tour of investigation of the communicating systems of Europe. Mr. Bell visited Great Britain, Norway, Sweden, Denmark, Holland, France, Belgium, Italy and Spain.

Sweden is following a long-sighted policy of internal development. It is busy just now harnessing the water power of its more northern provinces with the intention of electrifying its entire railroad system. It is installing a huge underground telephone cable system which will be second in length only to the line now operating between Boston and Washington. The material for this Swedish cable project is being manufactured in this country at the works of the Western Electric Co. at Chicago.

Great Britain, Holland and Norway are reorganizing their telephone systems to provide for the introduction of machine switching methods similar to those now proposed for use in this country. The first two nations also are installing underground cables for toll purposes. Italy is busy on plans to connect its more important cities by toll cables. Automatic exchanges are also being considered. France is going ahead on a program of restoration. Her lines of communication in the battle area and elsewhere are to be reorganized on a plane far better than that of prewar days. The Baudot system of telegraphy is in use. At least 80% of the French telegrams are handled by the printing-telegraph method.

Denmark which has always been one of the most up-to-date of European countries in the world in telegraph development is continuing its research efforts. The Larnsen undulator, a very delicate telegraph instrument is now used all over the globe. Gulstad, one of the present school of Danish inventors, produced the self-vibrating relay which has been adopted in modified form in the United States. Belgium is practically back to normal as far as the electrical industry is concerned. Just as she has set a fast pace for the other warring nations in her industrial rejuvenation, so her lines of communication are operating again on an exceptionally smooth running basis.

Spain possesses the most ornate telegraph office in Europe. The new Palacio de las Comunicaciones at Madrid is a remarkable structure, fitting in admirably with the efforts of the Spanish aristocrats to make their capitol one of the most beautiful cities on the globe. The office is managed by a staff of energetic officials who are leaving no stone unturned to improve their service. Germany is flooding the Scandinavian countries with technical literature. She is carrying on an active campaign to regain her trade in electrical and kindred apparatus among her northern neighbors. Her agents are present everywhere.

The Western Electric engineer states that the youth of Scotland is taking a marked interest in technical education. The West of Scotland Technical College in Glasgow is crowded to capacity, day and night. Its student body includes both men and women, all of them enthusiastic over the possibilities of their chosen profession. Even among the young Scots where lack of an adequate education foundation prohibits attendance at college, Mr. Bell found them busy in the night schools endeavoring to obtain a clearer knowledge of the intricacies of modern science and its applications.

INSULATOR DATA ASSEMBLED IN A CONVENIENT FORM.

Sizes, Shapes and Dimensions Tabulated and Illustrated, Together With Information Relative to Standard-Package Weights.

The R. Thomas and Sons Co., East Liverpool, O., has just published a well-arranged booklet showing the various detailed sizes, shapes and weights of various styles of porcelain knobs, tubes, cleats, bushings, and related materials. In addition to diagrams showing the various dimensions in both English and metric standards, tables show the number of pieces in a standard package and the weights for both domestic and foreign shipment. The information contained in this book should be of considerable value to anyone concerned in any way with the use of such materials.

Construction Accounting Under Uniform System

Each Item of Expenditure Classified and Recorded in Form to Segregate Costs on Various Plants and Lines and on Various Specific Parts of Such Plants and Lines—Examples of Accounts

Improper accounting of construction costs in many cases results in an almost endless amount of trouble after the completion of a large job, or also a small job in some cases. Where improper methods are employed, particularly where operation starts before construction is completed, there are many opportunities to inject serious errors into the figures arrived at as the costs of construction. The accounting details shown herewith are taken from the accounting scheme prepared by the committee on statistics and accounts of the National Association of Railway and Utilities Commissioners.

The following outline shows the general and minor divisions of the "Fixed capital" account which, of course, includes costs of construction:

FIXED CAPITAL ACCOUNTS.

INTANGIBLE FIXED CAPITAL:
- Organization.
- Franchises.
- Miscellaneous intangible capital.

TANGIBLE FIXED CAPITAL:

Specific accounts:

Land:
- Steam power plant land.
- Hydroelectric power plant land.
- Gas power plant land.
- Transmission system land.
- Storage battery land.
- Distribution system land.
- General office land.
- Miscellaneous land devoted to electric operations:
  - Stores department land.
  - General shops land.
  - Garage land, etc.

Structures:
- Steam power plant structures.
- Hydroelectric power plant structures.
- Gas power plant structures.
- Transmission system structures.
- Storage battery structures.
- Distribution system structures.
- General office structures.
- Miscellaneous structures devoted to electric operations:
  - Store department structures.
  - General shop structures.
  - Garage structures, etc.

Generating plant—Steam:
- Boiler plant equipment.
- Prime movers and auxiliaries—steam.
- Turbogenerator units—steam.
- Electric plant—steam.
- Miscellaneous power plant equipment—steam.

Generating plant—Hydroelectric:
- Reservoirs, dams and waterways.
- Roads, trails and bridges.
- Water turbines and waterwheels.
- Turbogenerator units—hydro.
- Electric plant—hydro.
- Miscellaneous power plant equipment—hydro.

Generating plant—Gas:
- Gas producers and accessories.
- Internal combustion engines.
- Electric plant—gas.
- Miscellaneous power plant equipment—gas.

Conversion and storage:
- Conversion equipment.
- Storage battery equipment.

Transmission and distribution:
- Underground conduits.
- Poles, towers and fixtures.
- Overhead conductors and devices.
- Underground conductors.
- Services.
- Line transformers and devices.
- Line transformer installation.
- Consumers' meters.
- Meter installation.

Consumers' installations:
- Commercial lamps.
- Street lighting equipment.
- Electric appliances.

General equipment:
- General equipment.
- Office equipment.
- Shop equipment.
- Stores equipment.
- Transportation equipment.
- Telephone, telegraph and wireless system.
- Laboratory equipment.
- Miscellaneous equipment.
- Miscellaneous tangible capital.

Overhead costs and other undistributed items:
- Engineering and superintendence.
- Law expenditures during construction.
- Injuries and damages during construction.
- Taxes during construction.
- Interest during construction.
- Miscellaneous construction expenditures.
- Fixed capital not classified by prescribed accounts.
- Cost of plant and equipment purchased.
- Unfinished construction.

As an illustration of how the accounting is worked out in detail on the basis of this outline the following limited extracts from the general text are presented:

GENERAL INSTRUCTIONS AND DEFINITIONS.

Fixed capital defined.—"By the fixed capital of a corporation is meant the property, both tangible and intangible, which is devoted to the accomplishment of the principal purposes of its business and which has an expectation of life in service of more than 1 yr. from date of installation in service.

Tangible and intangible capital and overhead costs.—"Tangible capital covers all physical property classed as fixed capital. Charges to specific accounts for tangible property cover direct labor and material costs up to and including the time of the foreman supervising the job; also such overhead expenditures for engineering taxes during construction, etc., as can be allocated to definite items of property. Charges to overhead cost accounts should cover only expenditures of this nature which pertain to the enterprise as a whole and cannot be allocated to definite items of property. Intangible capital covers organization expenditures and rights, privileges, and other property not physical, such as franchises or patent rights.

"So far as possible overhead costs should be assigned or apportioned to particular jobs or items to the end that each item shall bear its proper share of such cost, and that the entire cost of the item, both direct and overhead, shall be deducted from the fixed capital accounts at the time of its retirement. Certain overhead costs, however, which clearly pertain to the entire enterprise, such as in some cases engineering, interest, etc.,

should not be apportioned, but retained in the appropriate fixed capital accounts as part of the investment cost so long as the enterprise continues under the form in which it started.

"These instructions should not be interpreted as permitting the addition to fixed capital accounts of arbitrary percentages to cover assumed overhead costs, but only as requiring the assignment or apportionment to particular accounts for tangible property of actual and necessary overhead expenditures.

Fixed capital to be entered and retained on books at cost.—"All charges to fixed capital accounts shall be at the actual cost of the property acquired, at the time of its acquisition. A *bona fide* contract or agreement of purchase and sale between entirely separate parties shall be *prima facie* evidence of actual cost. Each item of property shall be carried in the fixed capital accounts at no more, and no less, than its actual cost unless, or until, such property is abandoned, replaced, reconstructed, or converted, when the accounting shall be as hereinafter set forth. The foregoing shall not, however, be interpreted to forbid the inclusion in "Fixed Capital Not Classified by Prescribed Accounts" of undisturbed book values which have been carried prior to the effective date of a prescribed uniform system of accounts, and which may or may not represent the actual cost of property in service; but the inclusion of such undisturbed book values in fixed capital accounts shall be without prejudice to any future determination of the actual cost of the property. The term "cost" includes not only the cost of labor, material, and supplies directly employed or consumed in the construction and installation of fixed capital, but also the cost of preliminary plans and surveys and such portion of the expenses for engineering and plant supervision and of general expenses as may be chargeable to the fixed capital accounts under an equitable plan for apportionment of such expenses.

First entries must enable identification.—"Every debit or credit to a fixed capital or other investment account must be made in such wise as to be readily identified with the particular item of property to which it relates. For each item (or project) of fixed capital or other investment the records shall show the date of the entry, the date of acquisition or installation, the date when placed in service, the actual money cost, and the description thereof with such particularity as to make possible the location and identification thereof (including in case the item is movable, the name of the manufacturer and the identifying mark or number, if any, imprinted thereon, and such other particulars as may be necessary for identification). Where two or more items are acquired under a single undivided contract the entry in respect of each shall refer to the others and shall state the entire consideration, and shall also state the portion thereof fairly applicable to the particular item covered by the entry. When any item of capital is withdrawn from service the date of withdrawal shall be included in the withdrawal entry relating to such item.

Note A.—"In the case of continuous structures like electric lines, gas mains, etc., the record shall be itemized to the extent that no item shall contain more than one operating division or section or more than one type of construction. The entry for any item shall so specify the location and the principal physical characteristics (such as size, weight, type, etc.) of the chief constituent parts of the item that identification may be assured.

Note B.—"The date when an item of fixed capital is placed in service may, if preferred, be kept in the engineering records.

Application of classification—"The accounts in this classification shall include all expenditures for fixed capital regardless of the way in which the funds for the construction or acquisition have been provided. Such expenditures shall not be charged to operating expense, income, surplus, or to special funds in such manner as to exclude from the property accounts any expenditure for fixed capital.

"These accounts shall also include the necessary credits to represent the cost originally charged to them of property or equipment abandoned, destroyed, sold, or otherwise retired from service. Wherever the term *original cost* is referred to in this classification, and such cost can not be ascertained, an estimate of the original cost shall be used."

Outlines of specific accounts showing what each is to cover are included below, taking certain subdivisions beginning with "Transmission and Distribution" under the general heading of "Structures."

Underground conduits.—"This account shall include the cost of all conduits and tunnels required for underground wires and cables, including manholes, ducts and pipe, sewer connections, sewer traps, and all material necessary for the completion of the underground conduit system devoted to the protection of the transmission and distribution systems.

Note.—"This account may be subdivided between transmission and distribution, if so desired.

Poles, towers, and fixtures.—"This account shall include the cost of towers, transformer platforms and structures for supporting other line devices, poles, crossarms, and insulator pins; braces, brackets, and other pole fixtures; guys and other supports for holding the towers, structures, and poles in position; and all labor expended in connection with the construction of pole lines or tower lines for carrying the transmission and distribution systems.

Note A.—"Separate subaccounts may be set up to cover the cost of towers, poles, and fixtures carrying transmission lines, that is, high-voltage lines used for transmitting power between stations or between points of generation or purchase and points of transformation and distribution, but not used to any considerable extent for carrying power to points of consumption.

Note B.—"The cost of ornamental street lighting poles and fixtures should not be charged to this account, but to 'Street Lighting Equipment.'

Overhead conductors and devices.—"This account shall include the cost installed of all overhead conductors and feeders (except services). This covers all cables, wires, insulators, and insulating material used in overhead systems; also ground wires, lightning arresters, pole-top switches, and other line devices.

Note.—"Separate subaccounts may be set up to cover the cost of conductors used in transmission lines, that is, high-voltage lines used for transmitting power between stations or between points of generation or purchase and points of transformation and distribution, but not to any considerable extent for carrying power to points of consumption.

Underground conductors.—"This account shall include the cost installed of all underground conductors and feeders (except services). This covers the cost of all cables, wires, insulators and insulating material used in underground systems.

Note.—"Separate subaccounts may be set up to cover the cost of conductors used in transmission lines, that is, high-voltage lines used for transmitting power between

stations or between points of generation or purchase and points of transformation and distribution, but not used to any considerable extent for carrying power to points of consumption.

Services.—"This account shall include the cost, installed, to the accounting company of all conductors, insulators, ducts, supports, etc., between the last poles before wires enter consumer's building on overhead services, or between the point where wires leave main and enter consumer's building on underground services, and the house-wiring. It shall also include the cost of meter-protection devices, such as inclosing meter boxes designed to prevent tampering with the meter or the meter connections.

Note A.—"All conduits, poles, wires, etc., from distributing mains to the points described above will be considered a part of the distribution system and their cost shall be charged to the appropriate accounts preceding.

Note B.—"If a consumer contributes some or all of the cost of a service the title to which remains in the accounting company, the amount of such contribution should nevertheless be charged to this account, but concurrently credited to 'Contributions for extensions.'

Note C.—"Cost of renewing or modifying service should not be charged to this account. If, however, the substituted service is of greater capacity than the one replaced, the book value of the withdrawn service should be credited, and the cost of the substituted service should be charged to this account.

Line transformers and devices.—"This account shall include the cost of all line transformers (both the overhead and underground), pole-line lightning arresters, transformer-cutout boxes, line-cutout switches, etc. It may be subdivided to show separately the investment in transformers and in other devices.

Note A.—"This account does not include the labor cost of installing transformers which is provided for in the following account.

Note B.—"This account may, if desired, include the cost of all transformers whether carried in stock or actually in service, provided designation of the account on the ledger indicates the practice of the accounting company, as, for example, by the addition of the phrase 'includes line transformers in stock.'

Line transformer installation.—"This account shall include the cost of labor and incidental expenses required for the original installation of line transformers. When any line transformer service is permanently discontinued, this account shall be credited with an amount representing the average installation cost of a line transformer.

Consumers' meters.—"This account shall include the cost of all meters, current-limiting devices, and appurtenances used or to be used in measuring or determining electric energy delivered to consumers. This covers in addition to cost of meters to point of delivery on the accounting company's premises such incidentals as the cost of meter badges and their attachment to the meters, testing and storing new meters, and the first set of meter fittings, connections, and shelves.

Note A.—"This account does not include the cost of the corporation's meters which record the output of the station. Such cost shall be charged to the appropriate power-plant electrical equipment account.

Note B.—"The cost of setting, removing, or resetting consumers' meters shall not be charged to this account.

Note C.—This account may, if desired, include the cost of all meters whether carried in stock or actually in service, provided the designation of the account on the ledger indicates the practice of the accounting company, as, for example, by the addition of the phrase 'includes meters in stock.'

Meter installation—"This account shall include the cost of the first setting of meters for determining the amount of electric energy delivered upon the premises of consumers. When any meter service is permanently discontinued this account shall be credited with an amount representing the average installation cost of a consumer's meter.

Note.—"Cost of removing consumers' meters and of setting other meters substituted for them shall not be charged to this account, but to 'Distribution, operation and maintenance,' or the appropriate subdivision thereof.

Commercial lamps.—"This account shall include the cost to the accounting company of all commercial lamps loaned or rented to consumers, and the cost of the first installation thereof, in case it is the policy of the company to capitalize such costs; otherwise the cost should be charged to the appropriate operating expense account.

Street lighting equipment.—"This account shall include the cost to the accounting company of all lighting equipment operated and maintained under the contract for public lighting entered into with the municipality. This will include public arc and incandescent lamps and their suspension devices; also ornamental lamp posts and fixtures for public incandescent lamps including the lamps. This account does not include the circuits, nor poles and fixtures supporting the circuits.

"If the company has an investment in street lighting equipment operated and maintained under a contract with a public body or organization other than a municipality, such equipment shall be included in this account under a subhead.

Electric appliances.—"This account shall include the cost to the accounting company of electric motors, heaters, etc., leased or held for lease to consumers (including municipal corporations), but not of those held for sale.

Note.—"The cost of setting and connecting such appliances on the premises of consumers, and the cost of resetting or removal, should not be charged to this account.

General equipment.—"This account shall include the cost installed of all equipment coming under the following heads:

(a) *Office equipment.*—"This includes the cost of all office and service equipment not permanently attached to buildings, such as desks, chairs, tables, movable safes, filing cabinets, drafting-room equipment, typewriters, adding machines, addressographs, portable lamps, lockers, clocks, fans, chronograph systems, pneumatic-tube systems, lunch room equipment, doctor's equipment, pulmotors, mechanical office appliances, floor coverings, and other like office appliances and equipment. Small articles of slight value or of short life should not be charged to this account, but to the appropriate operating account.

(b) *Shop equipment.*—"This includes the cost of all equipment specially provided for shops (but not so permanently attached as to be properly chargeable to 'Structures') such as furnaces, boilers, gas producers, engines, electric generators, and other power apparatus operating machinery in such shops; machine tools, frames, hoists, shafting, belts, and the like shop equipment; also such smithing equipment in shops as is used principally for other general purposes than shoeing horses and repairing vehicles; and all specially provided foundations not expected to outlast the machinery or apparatus mounted thereon.

(c) *Store equipment.*—"This includes the cost of all equipment for the receiving, shipping, handling and storage of materials and supplies. This includes loading and unloading equipment (except cranes when they are of such a nature as to be charged to buildings), derricks, portable cranes, hoists, chain falls, scales, trucks, counters, shelving, wheelbarrows, and the like.

(d) *Transportation equipment.*—"This includes the cost of equipment for general transportation purposes such as automobiles, motor trucks, trailers, tractors, motor cycles, and other vehicles;

battery-charging outfits, gasoline and oil storage tanks and pumps, and other garage equipment; horses, harness, drays and wagons; equipment for shoeing horses, and equipment for harness repair shop, vehicle repair shop and automobile repair shop, if this equipment is devoted exclusively to these purposes.

(e) *Telephone, telegraph and wireless system.*—"This includes the cost of all telephone, telegraph and wireless lines and equipment for general use in connection with electric operations, such as poles and fixtures used exclusively for telephone and telegraph wires; wires, cables, insulators, booths, instruments, switchboards, gongs, dynamotors, towers, antennae, etc.

(f) *Laboratory equipment.*—"This includes the cost of all meter and other testing apparatus and laboratory equipment not elsewhere provided for.

(g) *Miscellaneous equipment.*—"This includes any other miscellaneous equipment not elsewhere provided for, such as construction equipment, including boilers, engines, motors, hoists, concrete mixers and distributing apparatus, pumps, air compressors, riveters, lathes, power saws, pipe machines, forges, steam hammers, pile drivers, steam shovels, lighters, industrial track and cars, etc.; and any equipment of a permanent nature which cannot be properly charged to any of the foregoing accounts.

Note A.—"The cost of small portable tools and implements, such as hammers, saws, wrenches, files, jacks, wire cutters, climbing irons, etc., shall not be charged to this account. Such items shall be carried in 'Materials and Supplies,' until issued for use when 'Materials and Supplies' shall be credited and the appropriate work order or other account charged with the cost of the tools or implements so issued. The cost of maintaining tools and implements shall be charged to the expense of the department to which they are assigned.

Note B.—"So far as practicable, separate subaccounts shall be maintained for the equipment of each individual office building, shop, garage, etc."

The other items in the "Capital Account" are worked out in similar detail, together with full treatment of all other accounts, in the publication from which these extracts are taken.

SUGGESTIONS AS TO TRANSMISSION COSTS AND RURAL SERVICE.

Paper Presented Before Recent Meeting of Missouri Association of Public Utilities—Farm and City Service Compared.

By N. T. Wilcox,
Missouri River Power Co., Keokuk, Ia.

During the past 2 or 3 yrs. many companies distributing through extensive and growing rural systems have awakened to the fact that city or town conditions and practice with limited areas and consolidated distribution, and relatively low costs per customer, are returning a profit while many rural systems are really far from profitable. In most cases analysis of rural service discloses that cost conditions surrounding such service per unit are materially greater than for town service. In reality the rural system is furnishing a valuable service and the customer is paying for a few kilowatt-hours instead of for the commodity that he is purchasing that is a valuable service. The minimum charge exacted, if it exists at all, is absurdly small and no reflection of the actual value to the customer. Those of us who have grown up with the industry and have been consistent optimists and boosters are so because we realize that adequate and proper service, because of its many possibilities in practical application, is or at least may be an actual money maker for the customer as well as for the distributing company. Money can be made for the farmer even when the total charge for this service is many times the amounts popularly supposed to represent the sums possible to be obtained for rural service.

Before making the following statement some education may be needed not only for the farmer but for the central-station man. The statement that a good, well-managed, 160-acre farm in the Middle West can well afford to pay $50 per mo. for complete electric service at the present time may seem decidedly optimistic. But may we not venture to say that 10 yrs. hence this statement will be considered a most reasonable one. Let us consider the many practical applications of electric power to farm requirements. In the house we have lighting, cooking, refrigeration, fans and ventilation, cream separation, churning, water pumping and many other conveniences which go to lighten labor and make life pleasant. In the farmyard or about the place we may have electricity for lighting, grinding feed, sawing wood, pumping, cold storage, milking and various miscellaneous labor-saving applications where electric power is conceded superior to other powers.

Consider the increased comfort resulting in the farm home and the great saving of labor and human energy made possible by electric service outside of the house. The automobile has brought the farmer and his family practically into town. Electric service brings him most of the advantages of the city without the disadvantages.

A careful and competent analysis will reveal a possible saving of labor costs which are surprisingly large. It will also be discovered that in many cases the farmer can afford to pay his $50 per mo. for service and out of his advantage still have another $50 for his own use as a result of utilizing this service, saying nothing of the fact that unlike labor, the electric power is on the job and ready to do its part at any time during the 24 hrs. without a hint of strike or asking for an increased wage. The efficiency is also uniform instead of variable according to the health or mood of the laborer.

Educational work and good salesmanship, as well as common sense, together with commercial sense and energy, are required to succeed in really selling rural service. Time will also be required to develop this business although much less than formerly owing to the general acceptance of the advantage to be derived from superior service. The point we desire to emphasize is that the possibility is present for those men who recognize the fact that the supply of electricity to outlying and sparsely settled districts is a valuable service and to be charged and paid for accordingly.

Territory must be carefully mapped out and studied in advance and careful and consistent plans of campaign laid out in order to insure success. Rates for service must be carefully considered beforehand. Inadequate hit or miss methods must not be tolerated. We must act intelligently if we are to sell the service and reap the reward in the continuous profit which may be expected. From $1200 to $2400 per yr. per sq. mi. served is all we can probably expect from strictly farm

service in the Middle West, at least for some time to come and as long as the farms average in size as large as at present. Small hamlets and towns here and there will, however, tend to increase the totals.

When we consider that a good-sized town, covering 10 sq. mi., can be made to supply an electric income of as high as $15,000 or $20,000 or more per sq. mi. and at high load factor, we can readily see why the kilowatt-hour is the basis of charge in town and why the charge for service is overlooked in this instance. In the country, however, it is possible that we will be able to sell at most not more than 4000 or 5000 kw-hrs. per mo. per sq. mi., probably less.

It is evident from these considerations that the farmer must pay for his own transformers and meter equipment and for service—not for kilowatt-hours—at the rates generally prevailing. How shall we meet these conditions and assure an adequate and reasonable return for service rendered? It is quite evident that we cannot sell entirely on a kilowatt basis, although we need a meter to check abuse and waste. It is also quite evident that we cannot read meters every month and furnish the same detail and expensive service required in town with its consequent high cost.

Automobile and truck service for country districts run up expense and must as far as possible be avoided. The low return per mile also means that we must have the lowest possible construction costs consistent with service. This construction must be such as not to subject the customer to any except quite unusual interruptions for the reason that the whole foundation of the business rests on satisfactory service. If we have poor lines and poor maintenance and supervision we shall not be rendering the valuable service for which we should demand and receive an adequate return.

To allow comparatively low rates for the service we must have the best possible development of the territory served. This means intensive and energetic work so that the time required to develop may be reduced to a minimum, also satisfactory line construction such as will prove really economical in the long run and afford the satisfactory service that will be required to develop and hold the business.

Assuming that the working voltage for the main trunk lines is 33,000 volts and that branch lines are 6600 volts, for the purposes of this estimate and of outlining the situation in a rough way, we approximate costs as follows:

	Per mile.
Trunk lines, including right of way, etc	$3000
Side lines	$1200 to 1500
Taps	1000

In figuring costs something must be added for engineering, supervision, general and overhead expenses, and interest during construction. Estimates generally lack these items, which may account for some wonderfully low estimates.

Assuming that the territory served contains an average of four 160-acre farms per sq. mi. and that only 50% of possible customers are obtained, then the transmission line costs, outside of allowance for generating plant, would appear somewhat as follows:

Proportion of trunk line investment per farm inside of district served	$ 140
Proportion of side lines and taps	860
Total	$1000

Fixed charges, taxes, depreciation and interest at 15% would be $150 per yr., or $12.50 per mo. To this should be added at least $1 to cover patrolling and necessary meter reading, etc. With a 100% development—i. e., every farm served—the $12.50 charge would possibly be reduced to $7 or $8 per mo. per customer, but as this development cannot be expected for some time to come the latter figure has not been used.

The above should be the minimum charge per farm before any allowance is made for kilowatt-hours used either in doing work on the customer's premises or for energy utilized in 24-hr. losses in transformers, meters, etc. It is assumed also that the farmer will pay for his own meter, transformer, switch, and, if necessary, lightning arresters as well as all lines on his own premises. In totaling these figures we are assuming a capacity of 5 kw. per customer who would require about 36 kw-hrs. per yr. for meter and transformer losses. In this case we have assumed 1200 kw-hrs. per yr. per kw. of capacity, or 600 kw-hrs. per yr. for each customer.

A summation of the above figures, together with kilowatt-hour figures for each customer, would be as follows:

Transmission line charges, per year	$150.00
6000 kw-hrs. at $0.05 per kw-hr., per year	300.00
Total annual charge	$450.00
Per month	37.50

A $0.05 rate has been assumed but this rate will materially vary for different locations. How many farmers are paying this amount? If they are not paying this amount, how much are we actually losing on this kind of service when we charge only $2 to $5 per mo. minimum?

This paper has been written in the hopes that it may provoke discussion and serve to bring out the important difference between farm service and city kilowatt-hour charges and to emphasize the fact that rural distribution is essentially based upon a valuable service—not on kilowatt-hours sold. There is a question whether at best, even when taking into account all possible diversity and a very full development, the load-factor obtained in rural districts will be in excess of 25 to 35, or possibly 40%.

Those of us who have carefully analyzed problems of this kind, especially as to costs, will realize the necessity of education and helpful suggestions. Well constructed—not necessarily expensive—distributing lines if periodically and intelligently inspected, entail comparatively low costs for patrolling and inspection and are most economical. Good construction always means low maintenance. This especially applies to the high-tension insulators. The 33,000-volt trunk lines, if used, will, of course, require more attention than the lower voltage distributing lines, but if good construction and high-class insulators are used—say a 50,000-volt insulator—the attention should be small.

From the nature of things most rural lines must be financed by the people benefited. Generally speaking, many lines are too poorly constructed and maintained to be worth more than the amount usually charged to the customer, but in our discussion of this problem we are considering a business-like, well thought out plan which will produce continuous service and which will be alike profitable to the customer and to the company furnishing the service.

Electrical Construction Work in Northwestern States

Hydroelectric Plants Being Expanded and Remodeled—Larger Units Installed to Give Greater Efficiency and Increased Capacity — Lines Extended to Take on Water Pumpage Business

By W. A. SCOTT

The Portland Railway, Light & Power Co., Portland, Ore., early in the year made up a 1921 budget of improvements amounting to $1,643,000. Much of the construction work and new installations then projected have been in progress since last April. In addition to the items originally scheduled it is probable that other improvements and betterments may be undertaken later in the year that will increase the expenditure to $2,000,000.

The most important work is the installation of new equipment in the company's Station L in the city of Portland, which was begun last spring. The principal feature consists of a 15,000-kw., 11,000-volt, 60-cycle, horizontal General Electric turbogenerator. This unit will include an Alberger, surface condenser having 17,600 sq. ft. of cooling surface. Other plant improvements comprise six Babcock & Wilcox superheaters for the 444-hp. boilers originally installed there, and four sets of soot blowers in connection with superheaters. Also, new header valves of cast steel have been installed. Over $400,000 is being expended on this plant.

Other improvements provided for may be briefly summarized as follows: Overhead construction for power-line improvements and extensions are to be made at a cost of $250,000. The maintenance-of-way work scheduled for the company's urban and interurban railway lines is to be done at a cost estimated at $350,000. Then, the rebuilding of a steel and wooden bridge at the confluence of Sandy and Bull Run rivers will cost about $150,000. The proposed replacement of 50,000 ties on interurban car lines will cost $75,000. Plans for reconstructing and repairing car tracks, mostly in the city of Portland, will require the expenditure of about $175,000, and the 50 passenger stations and waiting rooms on interurban lines are to be repainted at a cost of $5000.

Equipment Changed From 33-Cycle to 60-Cycle Operations.

Important changes made within the last year at several power plants of the Portland Railway Light & Power Co. consisted in converting eight units from 33 to 60-cycle operation. Originally each of those units was built for 1100-kw., 33-cycle, 6-phase 330-r.p.m. service, and by the changes made each unit is now rated at 1500 kw., and operate at 60 cycles, 6-phase, at a speed of 360 r.p.m. It is said that those units, at the higher output, work much more satisfactorily than before. The company has material on hand for changing over in a similar manner an Allis-Chalmers generator in the Casadero hydroelectric plant, converting it from a 2500-kw., 3-phase, 33-cycle, 330-r.p.m. machine to a 3000-kw., 3-phase, 60-cycle, 360-r.p.m. unit. A similar change is to be made in one other unit. This will leave two vertical turbogenerators at Station E, and all the old hydroelectric units at Oregon City still operating at 33 cycles, all energy from which will continue to serve the electric railway.

It is of interest to note that this company's power lines have been connected with the plant of the Crown-Willamette Paper Co. at Oregon City, by which connection energy is served to the new unit in the latter's paper mill. A similar connection has been made with the stations of the Portland Gas Co., whereby the latter's rotary displacement pumps are being motor driven. Those pumps are for feeding high-pressure gas mains.

Construction Work of Pacific Power & Light Co.

The latest of the larger achievements of the Pacific Power & Light Co. was the recent completion of a steam-electric station and gas manufacturing plant at Astoria, Ore. These additional facilities were necessary to meet the industrial development at the mouth of the Columbia river. The site of the combined plant, situated on the north side of Young's Bay, was built up by hydraulic filling with a dredge. The steam-electric station is equipped with oil-burning boilers, so arranged that sawmill refuse may be used when deemed desirable, and a 3750-kv-a. turbogenerator and an outdoor transformer station whereby the electric energy is connected with the company's distributing system. The gas-making plant on the premises comprises two oil-gas machines, two gas holders and a 15,000-bbl. oil tank.

A considerable sum of money recently has been spent in the large territory which this company serves in the construction of transmission and distribution lines. Its main Yakima Valley transmission line, from Toppenish to Yakima, 25 mi. distant, is being rebuilt, and new substations have been constructed at Grandview, Benton City and Dayton, and for the Franklin County and Burbank irrigation districts, all these being in the state of Washington. The substations mentioned comprise both the outdoor type with concrete switch inclosure, and the small concrete structure for a switchhouse and office for the local representative. At the close of 1920 the Pacific Power & Light Co. was serving 31,170 customers for electricity, 9290 gas customers and 7164 water consumers.

The Northwestern Electric Co., having obtained

a franchise in Vancouver, Wash., several months ago, more recently extended an 11,000-volt line from Portland to that place, a distance of 6 mi. The building of the line involved crossing Oregon slough and the Columbia river. It was carried over both in a conduit supported by a railroad bridge, except for the stretch covered by the two draw spans. In each case the draw-span section consisted of a 3-conductor, 250,000-cir. mil. submarine cable. The submarine cable carries 37 copper strands in a 9/64-in. lead sheath. On the Vancouver side the energy is delivered to transformers by which it is stepped down to 2300 volts.

Plans of the company contemplate constructing a 14-mi. transmission line from Camas to Vancouver to transmit energy at both 11,000 and 66,000 volts.

North Coast Power Co. Builds Line for Irrigation Pumping.

Power-line extensions made early in the season by the North Coast Power Co. consisted of a line at Woodland, Wash., to supply energy to the pumping plant of Diking District No. 5, and a 3-mi. line at Hillsboro, Ore., to serve the new radio station of the Federal Telegraph Co. In the diking districts about 7500 acres of tillable land is reclaimed from overflow and seepage waters.

Regarding the electrical construction activities of the Puget Sound Power & Light Co., it is said that they include no major improvements at present. The considerable amount of new work in progress consists principally of various short-line extensions to serve new business, and includes a new section of the company's alternating-current underground distribution system in Seattle, as well as the installation of an experimental electric feed-water heater at its Western avenue heating plant in Seattle. There are, also, many minor improvements being made for the betterment of service, such as additional relay equipment and new feeders.

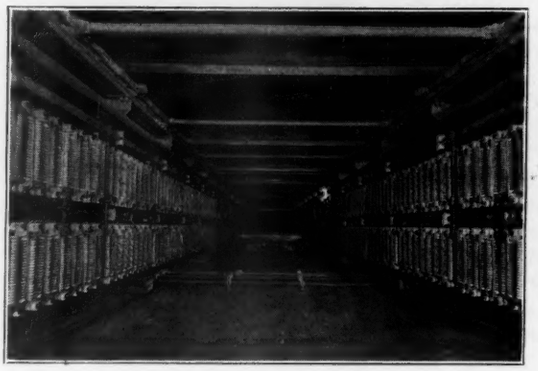
The most important project being carried through by the Washington Water Power Co. is the development of greater power production on Spokane river within the limits of the city of Spokane. This is being accomplished by the installation of a new 10,000-kw. generating unit by which the water of the stream may be utilized more efficiently. It is intended to supplant some of the older units of small capacity. The new unit, which is to be in service before the end of the year, will consist of an I. P. Morris vertical waterwheel of 14,250-hp. capacity, direct-connected to a General Electric 10,000-kw., 3-phase, 60-cycle, 4200-volt, 106-r.p.m. generator. The waterwheel, which will operate under a head of 64 ft., has a single runner and Moody spreading-type draft tubes, the casings and draft tubes being molded in concrete. The generator, equipped with General Electric spring-thrust bearings, is arranged for remote control from Post street station. The water will be delivered to the waterwheel through a steel penstock 500 ft. long, and 18 ft. diam. The construction work, which involves the building of a power house and a forebay wall, is in the hands of Grant Smith & Co.

The Great Northern Railway Co., which operates two 2500-kw. generating units at the mouth of its Cascade tunnel, west of Leavenworth, Wash., at 25-cycle frequency, has installed a frequency changer for one unit so as to be able to deliver 60-cycle energy at Wenatchee where there is a shortage of power during the season of pumping water for irrigation purposes. This plant, which is operated by water from the Wenatchee river, was installed primarily for running railroad trains through the 3-mi. tunnel that cuts below the summit of the Cascade mountains.

ELECTRICALLY HEATED OVENS FOR JAPAN BAKING.

Double-Deck Oven With Progressive Increase in Temperature Proves Entirely Satisfactory in Radiator Factory.

The McCord Manufacturing Co., Detroit, Mich., makers of automobile radiators, have installed in their plant an electrically heated japanning oven which possesses several features of interest. The oven, which was built by Young Bros., of Detroit, is of the continuous conveyor



Upper Deck of Japanning Oven in Automobile Radiator Factory.

type and is double decked, having two compartments arranged with one over the other. The work after being dipped is carried on a conveyor through the lower compartment, then back and through the upper, the exit of which is just above the entrance to the first. Both compartments have the same dimensions—10 ft. 4 ins. wide, 5 ft. 10 ins. high, and 60 ft. 10 ins. long. It is equipped with General Electric heaters and automatic control, the total connected load being 324 kw. The baking capacity is 3000 lbs. of radiator shells, the time required for a piece to travel through the oven being 45 min. from entrance to exit.

The heat is divided into three zones and is regulated by automatic control panels located just above the entrance to the ovens. The lower compartment is equipped with comparatively few heaters which are concentrated at the rear end. This gives a preheating zone in the forward end through which the work passes before being subjected to the maximum heat of the compartment—250 deg. F. The work is then carried to the upper chamber which is equipped with heating units for its whole length, the temperature in this compartment being 450 deg. F.

The Street Railway Commission of Detroit announced last week the opening of bids for 50 "trackless trolleys," to be purchased by the city and used as feeders of the municipally-owned lines.

Relay Protection on Extensive Power System

Generators and Transformers Provided with Differential Relays While Lines Require Balanced Relays as Well as Liberal Design—Time-Limit Protection Employed for Special Conditions

By E. R. STAUFFACHER
Southern California Edison Co., Los Angeles, Cal.

Due to the increasing size of generating units it becomes more important each time a new station is built to see that the generating machinery is properly protected. A generator, when equipped with protective relays, will in case of failure suffer a comparatively small amount of damage compared with that which would occur if it were not so protected. The damage caused by a short-circuit if confined to only a few coils would be very little to fear, but the damage is usually far greater than this. With the growth of the system the amount of energy which can go into a short-circuit in a generator would be sufficient to burn a considerable portion of the iron. This results in a repair job possibly covering months of time. Not only is this expensive and a loss to the company, but the loss in generating capacity is quite often of more consequence.

Reverse-power relays can be applied to the purpose of protection, but a method which has come into favor and which appears to be far more desirable is to use differentially connected overload relays. Their operation is independent of generated voltage or power-factor, and they will protect against occurrences of short-circuits in the generator or its leads, but they will not operate in case the generator has to carry a momentary overload. In applying this differential protection it is necessary that the neutral point of the *Y* winding of the machine be made exterior to the generator. The current transformers inside of this neutral point are balanced against similar current transformers on the leads of the machine and the relays are connected across the secondaries of the current transformers. From the relays the connections to the tripping circuits are so made that the closing of the relay contacts will disconnect the armature circuit-breaker and an instant later the field circuit-breaker and, if necessary, energize a solenoid which will trip the governor. This method of protection is in use at the Kern River No. 3 plant and similar equipment has been ordered for the Big Creek No. 8 plant.

Transformers Protected by Differential Relay Connections.

The increasing size of the generators has a tendency to increase the size of the step-up transformers as well. These large and expensive transformers justify all means of protection which can be installed. The question of the burning of the iron is not so important in the transformer as in the case of the generator, but due to the fact that transformer coils are so designed that they occupy such a small space and are so compactly installed a short-circuit inside a transformer results in burning so serious that a considerable repair job is generally the result.

One of the most effective methods yet proposed for the protection of transformers has been that similar to the generator protection outlined above; that is, current transformers are connected in both high- and low-tension leads of the power transformers and the relay is connected across the secondaries of the current transformer so that it will operate only when current flows toward the transformer from both the high- and and the low-tension sides. By this method of protection the relays can be set quite sensitive and consequently they can operate and close the contacts to the tripping mechanism of both the high- and the low-tension circuit-breakers before any serious burning of the transformer coil results. A transformer protected in this way is being designed for Big Creek No. 8 station.

Transmission Lines Require Both Liberal Design and Relay Protection.

Considered from a broad standpoint the freedom of transmission lines from interruptions depends upon the care and the liberality with which they are designed. The design of the towers, choice of insulators, clearance from the ground, and the application of lightning or surge arresters all contribute to the continuity of service over a transmission line. After the above conditions have been taken care of it remains for the protective relays to be applied if service interruptions are to be kept down to a minimum. Where duplicate parallel lines are installed it is possible to keep one line working continuously while the other can be held in reserve. However, a considerable saving in line losses can be accomplished if these transmission lines are both energized in parallel. To operate in this manner, however, necessitates the use of some protective device to isolate a defective section of line when short-circuits and grounds occur. With this end in view balance-head relay protection was applied to the Kern River No. 1 lines at three of the most important stations between Kern River No. 1 and Los Angeles, during the latter part of April, 1920. Since that time the operation of the relays has resulted in a marked freedom from interruptions, such as existed several years before. There have been approximately 62 operations of the relays since their installation and June 1, 1921. Of these operations the greater percentage have been correct; that is, the defective section of line and

that section only, has been isolated leaving the remaining section to carry the load, all of which prevented an interruption. About the only knowledge the consumer has of trouble on our lines is a slight blink of light at the time the defective section is eliminated. The incorrect operations have been due almost wholly to faulty transmission line design, such as connecting a tap from another substation to the transmission line between substations where balanced relays are installed. This has a tendency to unbalance the line at this particular section whenever a short-circuit occurs at any place throughout the length of the transmission line. Other causes of a few of the faulty operations have been defective tripping mechanism on the oil circuit-breakers, open-circuit in the tripping coil, and a defective contact on some of the auxiliary pallet switches.

Balance relays have also been installed at the Vestal substation to protect the line between this substation and Kern River No. 3 generating station known as the Greenhorn line. Since they were put into service on April 11, 1921, there have been 15 operations, only one of which has been faulty. Due to the peculiarity of load conditions in this territory it will be necessary that one of the two generators at Kern River No. 3 operates at 60 cycles, while the other operates at 50 cycles. This, of course, will prohibit the use of balance relays. When operating under these conditions the lines will be separated and will be protected by reverse-power relays at Vestal, so connected that they will not operate except when current flows in excessive amounts toward the Kern River No. 3 generating station. This is really the initial installation of reverse-power relays on the Southern California Edison Co.'s system since the modern type of reverse-power relay has been designed. The transformer, the frequency changer and the outgoing line at Vestal are all protected by induction-type overload relays, and there have been several occasions since the beginning of operation at this substation where they have more than justified the cost of their installation. The operator at this station, the load dispatcher in Los Angeles, and the engineers in charge of the installation are all quite enthusiastic over the performance of the relays here, and as a consequence all new stations when designed have proper provision made for the installation of the necessary protective relays.

Definite-Time Relays Employed for General System Protection.

There is one particular installation of definite-time relay which has been designed and built by the engineering department of the company and which is installed at one of the most important substations on the system, namely, Newmark. Lines coming from the Long Beach steam plant, the Los Angeles No. 3 substation which receives a good share of the Kern River No. 1 power, from Eagle Rock substation which receives the greater portion of the Big Creek power, and from the substation at Puente which receives practically all of the power from the small east end hydraulic plants all come through Newmark. If a short-circuit occurs anywhere on the system and the switches at Newmark "kick out" the system is badly disorganized. To overcome this difficulty an installation of definite-time relays was made about 18 mo. ago. These relays are so designed and adjusted that no matter how severe the short-circuit it will take only from 1.5 to 2.5 sec., depending upon the adjustment, for the switches here to "kick out," and consequently the trouble is cleared at some other point and the system is held together.

This brief description will give an idea of a few of the things on which the Southern California Edison Co. is working in regard to protective relays. When the system is protected 100% by a modern up-to-date equipment, installed in an intelligent manner, the service interruptions will be materially decreased.

With the growth of the system, and the dependence of the inhabitants of California upon the system, it is important to see that the consumers are at all times furnished with uninterrupted power supply, even if the power is generated hundreds of miles distant and its distribution lines cover half the state.

LIGHT CREOSOTE OILS IN WOOD PRESERVATION.

Light creosote oils properly injected into wood apparently will prevent decay until the wood wears out or until it checks so badly that the untreated portions are exposed. Such is the indication of service records collected by the Forest Products Laboratory on railway ties and telegraph poles preserved with low boiling creosotes.

Creosotes used in ties from 25 to 50 yrs. ago were for the most part oils having 50% or more distilling below 235 deg. C., with a residue not to exceed 25% at 315 deg. C. The ties so treated lasted from 15 to 20 yrs., and failure was traceable in most cases to mechanical wear, such as rail cutting and spike killing. In no case was failure found to be the fault of the preservative.

Of 1558 telegraph poles in the Montgomery-New Orleans line which were pressure-treated with a light creosote oil, 1049 poles were still sound after 16 years. In 91% of the cases of decay the fungi had entered the wood through checks and shakes. Representative sections in the Norfolk-Washington line showed that after 17 yrs.' service, of the 1614 poles inspected, 1469 were sound, 92 decayed at the top, and 105 decayed at the ground line. The decay at the top was caused chiefly by cutting off the poles. In those decayed at the ground line, the causes of failure, as determined in 88% of the cases, were checks or shakes. Here again as in the ties the preservative outlasted the mechanical life of the wood.

Unless some other factor than protection from decay is considered important, therefore, there is apparently no need to specify high boiling oils. The important point is that any coal tar creosote which is not extremely low boiling or extremely high boiling will satisfactorily prevent decay, and in the selection of an oil, factors such as price, penetrability and convenience in handling should receive greater consideration than moderate differences in volatility.

One person in a hundred in Russia has a telephone; one in three hundred has electric lights; one electric washer is owned for every 12,000 persons.

Changing Voltage of Induction-Motor Winding

Phases May Be Connected with Coils in Series, in Series-Parallel or in Parallel with Entire Circuit Joined in Star or Delta Formation—Advantages of Different Methods—Difficulties Met

By JACOB GINTZ, Jr.

To change the connections of a 3-phase induction-motor winding the same precautions as to the condition of the slot insulation, also the insulation on the wire, etc., must be taken as were outlined in the directions given for changing the connections of a 2-phase winding when it was to be operated at a voltage other than that of its original design.

An accompanying illustration, Fig. 1, shows the winding and connections of a 3-phase 4-pole

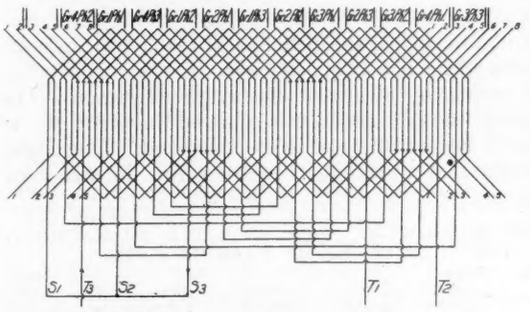


Fig. 1.—Connections of a 440-Volt, 3-Phase, 4-Pole, Star-Connected Induction Motor.

induction-motor winding having 36 coils—star or *Y* connected—to be operated on a 440-volt, 3-phase circuit. This winding is to be reconnected so that it may be operated on a 220-volt 3-phase circuit. There are two methods by which this change can be accomplished: First, by regrouping the winding, and second, by changing the external connections from a star connection to a delta connection.

In the illustration, Fig. 1, there are four groups of coils in series per phase; in each group of coils there are three coils in series, making a total of 12 coils in series per phase. As shown in the diagrammatic sketch of the star-connected circuit, Fig. 2, between terminals *A* and *B* there are two

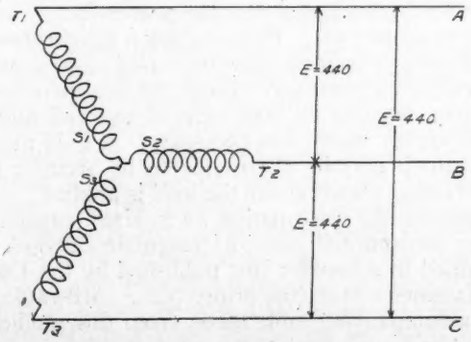


Fig. 2.—Diagrammatic Sketch of Star-Connected Motor Circuit.

of the three phases connected in series across a 440-volt supply circuit. If the method of regrouping the winding is selected it would mean that the connections must be so arranged that, instead of having 12 coils in series per phase to operate on a 440-volt circuit, only 6 coils in series per phase will be required on the 220-volt circuit. This can be accomplished by connecting the groups per phase in series-parallel—two groups in series and two groups in parallel.

As illustrated in Fig. 4, groups 1 and 2 are connected in series and are connected in parallel with groups 3 and 4—groups 3 and 4 are connected in series. This method of group connection is applied to each phase of the winding, as shown in the illustrations.

By comparing the two illustrations it will be seen that in the first one there are four groups of three coils, each in series per phase, while in the second one there are but two groups of three coils each in series per phase, thereby reducing the number of coils in series per phase from 12

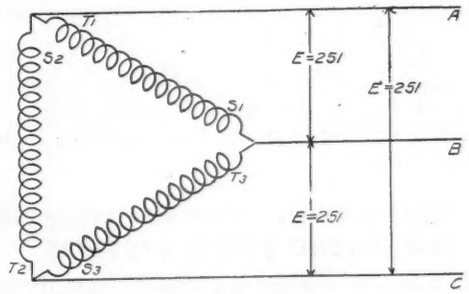


Fig. 3.—Star-Connected Motor Reconnected in Delta for Half-Voltage Operation.

to 6. This, in turn, allows the reconnected winding to run equally as well on a 220-volt circuit as it did on a 440-volt circuit.

If the method of changing from a star connection to a delta connection is selected it will only be necessary to change the phase connections. In Fig. 1 leads S_1, S_2 and S_3 were joined, while T_1, T_2 and T_3 were connected to the supply circuit of 440 volts. To change this to a delta connection it is necessary to open the connection between S_1, S_2 and S_3 and proceed as follows: Join T_1 and S_2 to one line, T_2 and S_3 to another line, and T_3 and S_1 to a third line as shown in Fig. 3.

The regrouping method is by far the more satisfactory, as the same style of winding conditions are adhered to, and as above mentioned the operation will be equally as well after the reconnection as it was before. The changing from star

to delta is not as satisfactory, because there will be a difference in voltage required for equal operation. If a 440-volt star-connected circuit is changed to a delta circuit the voltage changes

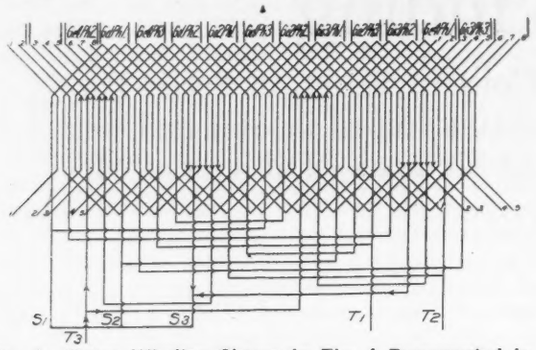


Fig. 4.—Motor Winding Shown in Fig. 1 Reconnected in Series-Parallel.

to 251+ volts; so, then, to have the machine connected as in Fig. 5 it would require 251 volts to produce the same results as will be obtained by using the connection as shown in Fig. 4 and

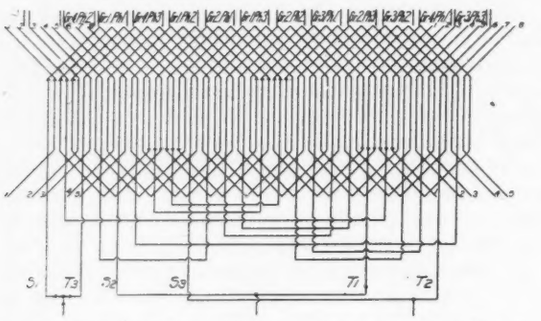


Fig. 5.—Motor Winding Shown in Fig. 1 Reconnected in Delta.

using a 220-volt circuit. Under the conditions shown in Fig. 5 the copper heating would be about ⅓ greater than under the conditions shown in Figs. 1 and 2.

SOUTHWESTERN PUBLIC UTILITIES IMPROVING THEIR SYSTEMS.

In the face of the much discussed state of dormancy in industry and its resultant tendency to slow up progress in the public utility field, it is refreshing to note that one section of the country still manages to "carry on." That part of the Southwest which centers about Kansas City is leaving no stone unturned in clearing the way for better service from its railroads, its lighting companies and its power stations. The Midland Valley Railroad Co. which operates a 300-mi. line from Fort Smith, Ark., to Wichita, Kan., is busy just now changing its train dispatching service from the old Morse telegraph system to the latest Western Electric telephone method. It has adopted apparatus similar to that used on the "Katy" System and the other larger Southwestern railroads. The heart of the new dispatching system is located at the Midland headquarters of Muskogee, Okla. There will be 37 other dispatching stations.

Another step in the right direction is the installation of a new high power electric power line from Bristow to Paden, Okla., 30 mi. away. It is an improvement that has been contemplated for several years. Other towns along the line will get the benefit of its service later through a series of branch trunks. Kansas City has followed the lead of most of the larger cities and is arranging to put most of its electric light and power lines underground. The Kansas City Power & Light Co. has just secured 60 carloads of underground conduit from the Western Electric Co. to get the project started. The initial shipment will enable the lighting company to put almost 57 mi. of its system out of sight.

MAGNETIC CLUTCHES USED WITH SYNCHRONOUS MOTORS.

Data Relative to Power, Speed, Power Consumption, Weight and Application of Magnetic Clutches of Various Sizes.

Several large cement concerns, a flour mill and two or three pulp and paper mills have been able to improve the power-factor on their systems by the installation of synchronous motors and C-H magnetic clutches. The Bessemer Limestone & Cement Co. has installed seven synchronous motors and magnetic clutches for driving compeb mills, the high static friction of the mills being overcome by means of the magnetic clutch. The synchronous motors are allowed to come up to speed before the clutch is energized. The short interval of time which it takes for the magnetic pull between the clutch surfaces to attain its full strength allows sufficient slip to secure a smooth start.

TABLE SHOWING DATA RELATIVE TO MAGNETIC CLUTCHES OF VARIOUS SIZES.

Size	Horse-power at 100 r.p.m.	Pull out torque lb. ft.	Current in Amperes 115 Volts	230 Volts	Max. r.p.m.	Net weight. lbs.	Shipping weight lbs.
7	.7	35	.4	.2	3540	70	85
10	1.7	90	1.0	.5	2840	90	110
12	2.8	150	1.0	.5	2380	115	140
14	4.7	250	1.2	.7	2040	155	185
16	13.9	732	1.6	.74	1790	235	285
20	27	1430	2.0	1.0	1420	350	430
24	47	2460	2.4	1.4	1190	510	640
28	75	3920	3.2	1.8	1030	700	880
32	111	5840	3.2	1.8	900	1080	1360
36	158	8320	4.8	2.6	800	1400	1760
40	198	10420	4.4	2.4	710	2000	2500
44	290	15200	5.2	2.7	650	2600	3200
48	376	19720	5.5	2.9	600	3300	4000
54	535	28100	11.4	5.8	530	4000	4800
60	735	38600	14.0	7.3	480	4800	5800
66	980	51400	14.1	7.3	425	6000	7000
72	1270	66600	17.3	9.1	395	6800	8000
78	2170	114000	19.3	10.4	365	8200	9700

In the case of a rubber mill 600 hp. was needed for new power plant equipment. The power plant was already overtaxed and the power-factor was down to about 65%. By installing a synchronous motor the power-factor was increased to 90% and the generating plant was so relieved that there was sufficient capacity to take care of the full additional 600 hp. which was necessary. A C-H magnetic clutch permits the motor to be brought to synchronous speed before the load is applied.

Considerable information as to sizes, capacity, power consumption, etc., of magnetic clutches is contained in a booklet just published by the Cutler-Hammer Manufacturing Co., Milwaukee. The accompanying table taken from this publication shows various interesting features of such equipment.

One Solution of the Porcelain Insulator Problem

Elimination of Moisture from Cement Prevents Expansion With Accompanying Ultimate Destruction of Porcelain Parts—Cement Impregnated with Pitch—Paper Before the A. I. E. E. Convention

By E. E. F. CREIGHTON and F. L. HUNT
General Electric Co., and Turner Falls Power & Electric Co.

Many years ago porcelain insulators on transmission lines began to crack in great numbers. In the earlier cases a few disks in many strings had cracked before the transmission engineers had discovered the condition. Indeed, there was at that time no reason to believe that insulators would deteriorate in any way. As a result of these many unobserved failures which simply reduced the factor of safety in each insulator one accidental failure finally introduced surges which punctured many other insulators that were just on the point of failure. These failures were tens of miles apart. Thereby the whole system was put out of use. Today these general failures are avoided by a systematic test of each disk at intervals of time depending upon the conditions of installation and the judgment of the transmission engineers.

The cause of most of the failures of these insulators may possibly be reduced to one condition, namely, the presence of the portland cement. To be sure, the portland cement at times was only indirectly the cause when it simply supplied the moisture which very slowly distilled into the porous porcelain. The most usual cause of failure of disks, however, was due to a characteristic of portland cement itself. When portland cement is dried out it shrinks. When it is again wet it expands not only back to its initial size, but a little more. In each cycle of drying and rewetting the cement increases in volume until it tightly fills the entire space between the metallic hardware and the porcelain. When this condition is reached an unusually warm day will cause an unusual expansion of the metal, and the resulting strain will be transmitted directly through the portland cement to the porcelain. A crack will result.

Changes in Design and Manufacture Have Improved Insulators.

Progress in decreasing these failures has been made by the manufacturers of porcelain insulators. For example, instead of resting the cap directly on the porcelain of the usual suspension insulator it is now separated by a slight clearance which prevents the cap from pushing the head off the insulator. This improvement is easily made and has no detrimental factor.

For the expansion of the pin the conditions have been possibly somewhat improved by the use of a layer of soft material next to the porcelain. Unless other conditions are made to conform with this change the insulator is weakened mechanically.

Improvements have been made in the matter of open porosity by greater care in firing. Some manufacturers have also endeavored to overcome this difficulty by glazing all surfaces.

In spite, however, of all of these conditions the older insulators on transmission lines from all manufacturing companies still fail in sufficient percentages to require the expense of a periodic test and examination. There is an amelioration without a cure. In other words, the life of the insulator has been increased, but the tests must still be continued.

The writers attempted to find several solutions of this problem, and there is described herewith the satisfactory results of one of these methods. Porcelain disks and hardware were purchased, unassembled, from a reliable manufacturer of insulators. The porcelains were all examined relative to porosity. They were all highly vitrified; in fact, there was not the slightest trace of open porosity in a single one of them. A few faults were on the side of overvitrification, which manifested itself in a detrimental way by slight checks. Punctures, where they occurred, took place through these checks. Very severe high-frequency voltages were applied by means of the well-known oscillator, the losses due to these extra severe tests being reasonable.

Expansion of Cement the Chief Cause of Insulator Failures.

The solution of the main problem—the prevention of failure of the present type of cemented insulators—lies in arresting the expansion of the cement. The easiest method of accomplishing this is by removal of the moisture from the thoroughly set cement and the prevention of its re-entering the cement. This was thoroughly done by impregnation under vacuum on a large number of the insulators, and was less thoroughly done on a portion of the insulators with the idea of determining the difference in life, if any, due to the difference in thoroughness of the impregnation.

In the endeavor to reach 100% results it was necessary to study the characteristics of portland cement when impregnated by different substances. One of the commonest impregnating substances of an insulating nature is paraffin. It was found, however, that a chunk of portland cement that had been thoroughly impregnated with paraffin by vacuum and heat treatment and then broken would still absorb moisture through the broken surfaces. A better material was therefore looked for. Some of the pitches were found to give

perfect results. Portland cement impregnated with pitch could be broken into small pieces and soaked in water for days without the slightest indication of absorption of the water.

As already stated, different methods of impregnation were applied. This work was done in the laboratory during 1917 and the spring of 1918. The majority of the insulators were given a thorough vacuum treatment under heat and were impregnated under pressure with the intention and hope of getting 100% perfection and a life of indefinite length—much more than 20 yrs. In order to get a forecast of the future laboratory processes of aging were developed. A large wheel 12 ft. diam., which is known in the laboratory as the Ferris wheel, was made and operated with the axis in a horizontal plane. Around the rim insulators were secured with bolts and these insulators were passed through a cooling box next to the floor and a heating chamber near the ceiling. The insulators were exposed to the air between these two extremes of heat, and an actual blast of moist air was turned on them as they slowly moved around. Here was a device, then, that gave the extremes of temperature and moisture from 20 deg. C. below zero to 120 deg. C. above. The range of temperature and moisture was exaggerated and the rate of change of temperature and moisture was also exaggerated above that found in practise with the idea of hastening any effect that might develop in actual practise. It was estimated that the effect of a single revolution on this wheel would give the insulator more severe strain than would take place in 6 mo. in practise—in other words, that two revolutions were equivalent to a year. In this way artificial tests were made extending over many years.

In criticsm of this method it should be pointed out that it does not give a thorough test of the distillation of moisture into porous porcelain, but it has already been pointed out that these insulators were absolutely without open pores and that consequently that particular feature was not of interest.

Another set of tests was made on these insulators which was more severe in the rate of change of temperature; namely, by changing from boiling water to freezing water every half-hour. By these methods we satisfied ourselves that the impregnation was effective and that the insulators were ready for installation.

Important Conclusions Resulting From Tests and Experiment.

A total of 1100 of these insulators, carefully marked, were installed on a 66,000-volt transmission line near the seashore in New England in July and August, 1918, and were put into operation in November, 1918. Up to the present time there has not been a single failure among the lot.

A total of 3600 other insulators of the same design, and built in the same factory, were shipped direct from the factory, having been assembled at the insulator factory, and installed on the same line at the same time as the others.

A test made on the whole line about a year after it was put into operation showed 13.5% of failures among the insulators which came direct from the insulator factory and no failure at all on those which had received the above described treatment. The insulators were then about 2 yrs. old.

Up to the present time there have been additional failures, amounting to 2 or 3%, among the insulators which came direct from the factory, but no failures whatever in the insulators in which the cement was treated.

Following are some comments relating to (1) the mechanical strength, (2) electrical tests treatment, (3) line testing, (4) aging of porcelain, and (5) open porosity of porcelain—which seem pertinent to the subject in hand.

(1) *Mechanical strength.*—In discussing the mechanical strength of insulators as affected by inpregnation of the cement, it is desirable to avoid the introduction of other factors which are independent of the treatment of the cement. For example, it is well-known that the geometrical dimensions play a leading part in determining the mechanical strength. A large head and a deep pin hole give more bearing surface for the cement and thereby increase the ultimate "pull" on the hardware. Therefore a type of disk and hardware will have a fairly definite mechanical strength if the cementing is done in the most favorable way.

If the cement is sufficiently set to transmit the force to give the ultimate strength of porcelain in tension (about 2000 lbs. per sq. in.) and, furthermore, fills the space between hardware and porcelain surfaces sufficiently snugly to transmit the mechanical force uniformly, what more can be asked of the cement? The type of insulator will then give its maximum mechanical "pull."

To arrive at this desired condition the manufacturing details depend on the application of a few scientifically determined factors. To illustrate briefly: The problem of attaining the proper conditions of the cement was approached by experimenting first with the two extremes. At one extreme the cement was set rapidly in live steam at a pressure of 120 lbs. per sq. in. Most of the disks came out of this treatment with the porcelain cracked due to the expansion of the portland cement. At the other extreme the cement was set for a few days only under conditions of normal room temperature. As a result, either the pin slipped out of the cement in the "pull" test (as was usual) or the cap slipped over the cement. Sufficient "set" and "snugness" of the cement may be obtained by a manipulation of the factors at either extreme—less time and steam temperature starting from the upper extreme or more time and temperature starting from the lower extreme.

It is impracticable to give details here in this brief account. The treatment must be adjusted to the type of cement. For example, some of the grey cements seem to have common characteristics. It is possible that refinements in the research would show variations in the cement of the same manufacture at different times of manufacture. We did not go that far. White cement showed the greatest expansion.

The important point in the proposed solution of this problem is that when the cement is given a desirable "set" and "fit" the impregnation excludes moisture which would otherwise change in optimum conditions as the cement grew older. The impregnating material must, of course, be of

such a chemical nature as not to attack the cement. If the factors which cause changes in the cement are excluded, why will not the cement remain constant forever?

(2) *Electrical tests.*—The insulators at the factory and also the specially treated ones in the laboratory were given severe high-frequency tests. Those authorities who have expressed their fear of permanent damage to the porcelain body by the severe electrical tests may feel inclined to explain the loss of over 13% in only 2 yrs. of life by attributing it to the severity of the tests. This would seem hardly tenable ground, since the insulators with impregnated cement were also given the severe electrical tests and none have failed. Is it not more probable that in the assembly of porcelain and hardware in the factory the particular cement and the particular treatment of it expanded the cement to a snug fit and the alternate dry and moist winds of the New England coast caused a further expansion of the tightly fitting cement, followed by a resulting breakage of the poreclain?

(3) *Line testing.*—Again it is desirable to emphasize the fact that 100% perfect insulators are a good investment financially, while the extra money expended in improving the insulator is of questionable economy. In one case the expensive and dangerous line tests are not necessary, whereas in the other case the line tests are still necessary although they may be made somewhat less frequently. It takes just as long to test 1000 insulators containing one defective as with a number of defectives. The goal is no testing.

(4) *Aging of porcelain.*—The aging of porcelain is a question frequently brought up. Distinction should be carefully made between the deterioration of insulators and the deterioration of porcelain. There can be no question regarding the former. There is, however, a grave question whether porcelain itself deteriorates with age. The series of tests of the application of heat, cold, and moisture to normal porcelain, which may be described at a later date, gave not the slightest indication of any change in the porcelain structure. By normal porcelain is meant the combination of clay, feldspar, and flint in the proportions of about 5, 3 and 2, respectively, and fired to a vitrification sufficient to do away with open pores. The time and temperature are of the order of 4 to 6 hrs. at about 1330 deg.

Tests used to discover any possible changes in the porcelain included puncture test on 60 cycles and 200,000 cycles, hysteresis tests, and impregnation tests of dyes on broken pieces of the poreclain. While it is tenable that improperly made porcelain, using certain grades of quartz instead of flint, and introducing other foreign chemicals such as might come in the ball clay or other ingredients, may deteriorate in time we have not yet found any such results in our researches. Porcelain protected by glaze is naturally free from moisture. It is, therefore, in an insulator subjected only to the range of atmospheric temperature and the mechanical strains due to the suspended transmission lines. While silica assumes a number of molecular conditions at unusually high temperatures there seems little likelihood that molecular changes at atmospheric temperatures could be a source of deterioration. The chance of deterioration is such a slight factor as compared to more evident conditions that we may properly relegate it to a secondary position for the present in analyzing the faults in porcelain insulators. To be sure, if the porcelain is openly porous and moisture is gradually distilled into the pores and is there frozen the expansion of the moisture in the cells of the porcelain may increase the porosity. This is not an argument proving the deterioration of porcelain with age, but an argument favoring the proper vitrification of the porcelain and the glazing of the surfaces exposed to moisture to take care of those inevitable cases of slight under-vitrification.

(5) *Open porosity of porcelain.*—In conclusion it should be noted that the use of dry impregnated cement solves also the problem of deterioration of resistance of porcelain due to the absorption of moisture. As an incidental auxiliary matter the manufacturer by request supplied a few special under-fired insulators for comparison, and a method of determining the under-fired condition without destroying the porcelain was tried. This laboratory test was of the nature of hysteresis loss in the material.

A period of 3 to 4 yrs. is not sufficient time to furnish absolute proof of the success of this impregnation method. More reliance is placed on the artificial aging test of the laboratory. There are points for discussion and debate and more work yet to be done.

FIGURES ON ELECTRIC AND STEAM CAR CONSTRUCTION.

A preliminary statement of the general results of the 1919 census of manufactures with reference to the construction of steam and electric railroad cars has been issued by the Bureau of the Census, Department of Commerce. Returns were received in 1919 from 121 establishments which manufactured 162,511 steam and electric railroad cars, valued at $403,517,000, these figures including such cars as were built in railroad repair shops, and as subsidiary products by establishments engaged primarily in other lines of manufacture.

CONSTRUCTION OF CARS FOR USE ON STEAM AND ELECTRIC RAILROADS—COMPARATIVE SUMMARY: 1919 AND 1914.

	1919.	1914.
Total cars built:		
Number	162,511	137,823
Value	$403,517,000	$164,960,000
Steam railroad cars:		
Number	160,159	134,960
Value	$389,078,000	$154,797,000
Passenger:		
Number	294	3,568
Value	$ 5,602,000	$ 45,245,000
Freight and other:		
Number	159,865	131,392
Value	$383,476,000	$109,552,000
Electric railroad cars:		
Number	2,352	2,863
Value	$ 14,439,000	$ 10,163,000

Of the total number of cars built in 1919, 160,159 were for use on steam railroads, and 2352 on electric roads. Only 294 steam passenger cars were constructed during the year as compared with 3568 in 1914, while, on the other hand, freight and other types of steam railroad cars increased from 131,292 in 1914, to 159,865 in 1919. The statistics for 1919 and 1914 are summarized in the following table. These figures are preliminary and subject to change.

EDITORIAL COMMENT

Line Protection Against High Frequency

A variety of devices have been provided for the protection of lines against abnormal conditions such as may be produced by lightning, by arcing grounds or even by switching. They consist mainly of arrangements which provide a path to ground from the line when the voltage reaches a predetermined value, while at the same time offering insulation to lesser voltages. Their use presupposes a high voltage as the only source of danger. There are, however, at times, surges of moderate voltage but of high frequency or at least very steep wave front produced upon the line, and it is desirable to provide a means of dissipating these. A recent suggestion offers a simple solution to this problem. It is to connect a condenser between line and earth. This is of such a capacity that at normal frequency the charging current is of no moment, whereas at excessively high frequencies the admittance of the condenser rises in proportion to the frequency, and the condenser current is of sufficient magnitude to relieve the line.

For high-voltage lines the problem becomes one of finding a suitable condenser, since it is not easy to design one with the necessary electric strength while having at the same time a suitable capacity. The use of such a condenser does not involve a spark gap with its uncertainties, it requires no attention, it does not permit current of line frequency to follow a discharge, and it is used without a series resistance, although a fuse should be provided to guard against the consequences of a possible condenser breakdown. The condenser does not afford protection against high voltages of low frequency, and hence does not displace the spark gap or other device for this purpose, but merely supplements it.

Porcelain Insulators

The failure of porcelain insulators has been the bane of the transmission line engineer for years past. Many theories have been advanced for such failures, and many proposals have been advanced for overcoming them. New methods of test, such as that at high frequency, have been tried in the effort to forestall the use of defective insulators, or to detect them on the line and remove them before breakdown occurred.

Continued study of the problem led to the localization of the seat of trouble in the cement. Expansion of the cement produces incipient cracks in the porcelain, and moisture will do the rest. Indeed, moisture starts the trouble. The expansion of the cement is due to absorbed moisture, especially when the absorption is alternated with drying out. To lessen the effect of such expansion, new designs have been evolved and these have lessened the difficulties. The process of manufacture has been improved and greater uniformity of product has resulted; in short, standardization has made its contribution. But troubles have persisted to a lesser extent.

At last a full measure of relief looms on the horizon. A method is proposed, and has been tried out in practice, to prevent the absorption of moisture by the cement of the insulator. The paper presented by Messrs. Creighton and Hunt at the annual convention of the American Institute of Electrical Engineers, and reproduced in full on other pages of this issue, marks an epoch in this subject. The authors have found that by impregnating the cement with pitch the absorption of moisture is entirely prevented. Insulators so prepared have been used for nearly 3 yrs. without apparent deterioration and without a failure. This is a remarkable record. If insulators which will behave in this way can be regularly produced and used, the need for periodic tests of the insulators on the line will disappear. Both trouble and testing can be eliminated. It may yet be too soon to say definitely that this has been accomplished. The performance already achieved gives promise of it, however, and offers real hope that the cemented insulator problem has at last been solved.

The following of this announcement so soon after the announcement of the fact that cementless insulators were ready for the market indicates that the entire problem is well in hand and that a complete and satisfactory solution will soon be reached if, in fact, such a complete solution has not already been found. Other manufacturers are working diligently on the problem, and with such concentrated effort success seems assured.

Improved Economy of Steam Turbine Units

Attention has frequently been called to the fact that the relative cost of generating power from fuel, as compared with the basic cost of coal or oil, shows a continual decrease. Two principal reasons given for this are the increasing efficiency

of prime movers, as designs are improved, and the increasing size of prime-mover units, which not only aids the attainment of higher efficiencies but makes the initial cost of the machine less per kilowatt and consequently decreases the item of fixed charges which must be considered in the estimation of the total cost of generating power.

The increased efficiency of prime movers acts in an indirect way to still further decrease certain items of cost. During the last 10 yrs. the steam consumption per kilowatt-hour generated under the most economical conditions by steam turbines has been reduced by about one-third of its former value. This means much more than a saving in coal. It means that the boilers and other steam-generating equipment need have a capacity only two-thirds as great as formerly for a station of the same output. Similarly, the condensing facilities are required to care for only two-thirds as great a quantity of steam and the expense for this part of the installation is correspondingly reduced. The fixed charges against these portions of a steam station are reduced in direct ratio to the cost of equipment.

Contemporaneous with the improvement in steam consumption of turbines there has been an improvement in the methods of firing steam boilers, so that boilers may fairly be given a higher rating today than was suitable 10 yrs. ago. This again means less investment in boilers for the same output.

These decreases in the required capacity of steam-generating and condensing equipment carry with them a lessened requirement in capacity of buildings and in the amount of land needed for a given power output. This means still another saving in fixed charges. Putting it in another way, it has been possible to largely increase station capacity without enlarging buildings or adding to the installation of boilers. In addition to all this the cost of water for condensing purposes, where such water must be purchased, is correspondingly decreased. This all goes to show that the increase in efficiency of steam turbines has acted to decrease the cost of power not only in the lesser requirements for coal and coal-storing and coal-handling facilities, but also indirectly from its effect upon the fixed charges for buildings and steam equipment.

Wages and Prices

Although the check to rising prices occurred somewhat later in England than in this country, the situation at present is much the same as it was here a few months ago, except that the crisis is more acute and the prospects for the future somewhat less bright. There is at the present time in England a terrible slump in all trades, and manufacturers and merchants find themselves loaded with goods which stand in their books at the unreasonably high prices which prevailed some time ago, but which are now falling. These people are disinclined to sell at a price lower than that which the goods have cost them; in other words, they will not "cut their loss," and the public, very wisely, refrains from buying because they know that the prices they are asked to pay exceed what the goods are worth at the present time.

It is no doubt difficult for the merchant or trader to realize that the only way in which he can get rid of a stock of merchandise for which he paid, say, $100,000, is to sell it for $60,000 or less, according to what the present market value may be. To wait for another rise in prices would be the height of folly.

These people are always inclined to forget that during the last few years they have in general profited largely by reason of abnormally inflated prices, and their actual loss in selling now below cost is not so great as it seems.

In regard to labor, the workingman has had the British Government "by the ear" for several years and has been granted everything he has asked for, with the result that it is now impossible to manufacture at a profit in view of foreign competition.

Reliable figures supplied to the writer from a private source indicate that skilled labor which before the war cost $100, now costs $242, while unskilled labor which cost $100 before the war now costs $346. It will be interesting to compare these figures with the increases in this country. In face of competition with other European countries which include the cheapest labor, and also in face of the adverse rate of exchange, it is not easy for the British manufacturer to sell his goods abroad. These conditions are reflected by the share market. The value of investments is dwindling almost daily, and the end of this unfortunate period of depression is not yet in sight.

Although no one will deny the right of the workingman to something more than merely a "living" wage, it seems unfortunate in view of the present crisis that the power of the trade unions had been so strengthened by the withdrawal of men to the army that they were able to dictate their own terms. Had they dictated their terms with the wisdom derived from a broad and sympathetic understanding of the needs of the country as a whole, the labor situation might have been much better than it is at present, but when a section of the community, which is notoriously short sighted, tries to satisfy its own desires by making unreasonable demands, backed by the power to enforce them, disaster is sure to follow sooner or later.

If the trades unions had insisted upon higher wages and at the same time seen to it that their

members worker longer hours when necessary, and improved or at least maintained the pre-war standard of efficiency, all might yet have been well; but with the higher wages came an insistence upon shorter hours, the tendency to slacking and a lowering of the standards of work with which other countries, not alone England, are familiar. Labor, as represented by the trade unions, has quite frankly and openly stated that while it was master of the industrial situation it was doing its utmost to better its position, even at the expense of other sections of the community; in other words, it was out to profiteer. Its arguments have not always been logical or free from contradiction.

On the other hand, those who are unprejudiced and not influenced by class antagonisms must realize that the prosperity of the workingman is in all respects desirable. Reductions in rates of wages have not yet been made in England as in America, and where wages have been forced up to unreasonable figures they will, of course, ultimately have to come down, and this is largely true of many classes of unskilled labor, including women workers.

Employers in England are, however, opposed to a general reduction in wages as they do not think it would lead to the prosperity of the country as a whole. What they are more concerned about is the means whereby adequate work will be performed in return for wages received. Many of the workers who now receive high wages are quite capable of earning them, but the fact remains that with the attitude of mind which is largely that of the trade unions, these men are not earning the wages which they are now receiving or which they received until the force of circumstances compelled the employer to dispense with their services and permit them to swell the growing ranks of the unemployed.

When labor propaganda is of a kind which will fit a man for his work instead of tending, as it does today, to make of him a less fit and efficient workman, a great improvement in the industrial situation is to be looked for. In the meanwhile the employer must play his part by attempting to educate the workingman and so make him a more efficient co-worker in the era of co-operation between employer and employe, which is bound to come if real and lasting results are to be finally attained.

Commercial Aspects of Electric Ranges

There should no longer be any question about the success or economy of cooking by means of electricity wherever a suitable rate can be secured for this kind of service. While a number of successful attempts at cooking on a large scale have been made in this country, the matter is not being pushed to the extent it deserves by the central station companies. In the hands of the latter the widespread adoption of electric cooking rests, because the whole question is merely one of a suitable rate, and since the load is largely an off-peak one this rate can with advantage be made in almost every locality. From the standpoint of satisfactory operation and achievement of desirable culinary results nothing remains to be desired. The best cooking of many substances requires a comparatively low temperature, and the electric oven is peculiarly fitted to supply this. The result is that the volatile portions of the food are not so completely driven off, thus attaining a greater weight and a finer flavor of the finished product. This not only affects the desirability of the prepared food, but has an appreciable effect that has been demonstrated in numerous cases upon the bill for supplies.

The problem is therefore only a commercial one, but just what rate fixes the commercial limit is not as yet established, and probably varies under the different conditions to be found in different communities. Manufacturers are doing their part in putting upon the market electric stoves and other utensils which are well adapted for carrying on almost every kitchen operation, and the fate of this application of electricity seems now to rest in the hands of the central station. If the new-business department will apply the proper energy to this question electric cooking should advance with great acceleration in this country. At present it appears that we are lagging behind our neighbors across the water in this particular development. England has great advantages in its density of population and its accessibility to cheap coal in furnishing power at low rates, but there are many places in this country where conditions are equally satisfactory not only in proximity to the coal fields but in places where hydroelectric power is available. It should be quite possible for most of our central stations to offer special rates for this type of load, making restrictions if necessary upon the hours of use.

One particular field where the load would unquestionably be off the peak is in the typical lunchroom of our large cities, where most of the cooking must be done in the forenoon. Many of these places are only open for the midday meal, and even where they are giving service for the entire 24 hrs. the great rush comes during the midday. These are, moreover, places to which electrical cooking is especially applicable, and their hours of maximum demand are certainly such as to earn an attractive rate. This business represents an opportunity which should not be neglected and which will not be overlooked when central station managers appreciate its importance.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

MICHIGAN ASSOCIATION TO MEET AT OTTAWA BEACH.

The Michigan Electric Light Association plans to hold its next annual convention at Ottawa Beach, Mich., Aug. 24-25, with headquarters at the Hotel Ottawa. The Program Committee has arranged for morning sessions on both days, with a banquet on Aug. 24. It is the committee's aim to make the program one of general interest where matters of policy may be discussed, the technical matters being handled by the Great Lakes Geographic Division of the National Electric Light Association. The afternoon of each day will be devoted to recreation when the delegates may enjoy all the pleasures of the resort such as bathing, boating and golf.

Those planning to attend the convention may make reservations for rooms direct with the hotel management. Inquiries regarding other matters may be directed to Herbert Silvester, secretary-treasurer of the Michigan Electric Light Association, Ann Arbor, Mich.

DISCUSS COAL ECONOMY IN SMALL STEAM PLANTS.

Addresses on Fuel Situation and Rural Electric Lines Among Convention Features of North Central Division, N. E. L. A.

The second annual convention of the North Central Geographic Division of the National Electric Light Association, held at Duluth, Minn., June 21-23, was pronounced by those in attendance as a decided advancement over the first convention, as well as more successful than any of the former conventions held prior to the reorganization of the North Central Electric Association into a geographic division of the National Association. All sessions were well attended and more interest in the papers and more discussion was in evidence than at any former convention.

The difficulties in bringing this new organization into shape were many and the success of the present officers was so appreciated that, with few exceptions, the same officers were re-elected in order that the foundations of the new association might be firmly laid and its policies and activities further developed with the present organization which have worked diligently to promote the interests of the membership.

The convention was featured by the following addresses and papers: "Public Utilities—The Public's Business," by Martin J. Insull, Chicago, retiring president of the National Electric Light Association; "General Business Conditions," by J. H. Ingwerson, First National Bank, Duluth, Minn.; "The General Relations Between Telephone and Electric Companies in the Matter of Construction and Operation of Lines," by C. B. Randall, counsel and secretary of the Tri-State Telephone & Telegraph Co., St. Paul, Minn., and R. A. Gantt, chief engineer of the Northwestern Bell Telephone Co., Omaha, Neb.; "Rural Electric Lines," by F. R. Winders, railroad commissioner of Wisconsin, Madison, Wis.; "The Fuel Situation," by W. T. Delihant, Jr., fuel agent of H. M. Byllesby & Co., Chicago, and "Coal Economy in Small Steam Plants," by J. J. Brennan, engineer of tests of the Northern States Power Co., Minneapolis, Minn.

The following officers were elected for the ensuing year: President, T. D. Crocker, Minneapolis, Minn.; vice-president, Lee Boyer, Deadwood, S. D.; treasurer, F. C. Hoffman, St. Paul, Minn., and secretary, H. E. Young, Minneapolis, Minn. The Executive Committee consists of W. S. Heald, Duluth, Minn.; E. G. Quarnstrom, Madison, S. D.; M. L. Hibbard, Fargo, N. D., and H. F. Thomas, St. Paul, Minn.

ELECTRICAL CONTRACTORS TO HOLD ANNUAL OUTING.

Due to the amalgamation of the Independent Electrical Contractors' Association and the Associated Electrical Contractors, it is expected that the 17th annual outing of the former organization which will take place at Midland Park, Grant City, Staten Island, N. Y., on Saturday, July 30, will be one of the largest in its history. A splendid affair is being planned and a good time for all is assured. Tickets may be obtained from S. J. O'Brien, 2145 Fifth avenue, New York City.

STATE COMMITTEES ORGANIZED IN GEORGIA AND ALABAMA.

N. E. L. A. Instrumental in Forming Public Utility Information Committees—Utilities Show Active Interest in Movement.

Organization of a state committee on public utility information has been completed for the state of Georgia. The committee will have its headquarters at 324 Healey building, Atlanta, and the work of the committee will be carried on by L. K. Starr as executive secretary. Until June 15 Mr. Starr was assistant city editor of the *Atlanta Journal.*

All of the large utilities of Georgia have shown an active interest in the movement and have pledged their moral and financial support. The Executive Committee which will direct the work is composed of Geo. T. Smith, Augusta-Aiken Railway & Electric Corp., chairman; P. S. Arkwright, Georgia Railway & Power Co., vice-chairman; C. D. Flanigan, Athens Gas Light & Fuel Co.; F. L. Marshall, Gas Light Co. of Augusta; H. C. Foss, Savannah Electric Co.; P. R. Bomeisler, Ware County Light & Power Co.; L. A. Magraw, Macon Railway & Light Co., and L.

K. Starr, executive secretary. George F. Oxley, director of publicity of the National Electric Light Association, and Labert St. Clair, of the American Electric Railway Association, met with members of the committee June 14 and 15 and assisted Mr. Starr in organizing and outlining his plans for conducting the work.

Mr. Oxley went to Montgomery June 16 where he met public utility men interested in the organization of a similar committee for Alabama. The preliminary organization work and the carrying on of committee activities were explained in detail by Mr. Oxley and it was definitely decided to organize an Alabama committee. S. B. Irelan, vice-president and manager of the Montgomery Light & Water Power Co., will have active charge of the organization of the committee, and the director of the work was tentatively chosen subject to confirmation by the Executive Committee when it is finally organized. It is expected that the committee will be fully organized and headquarters will be opened in Montgomery not later than Aug. 1.

While in the South Mr. Oxley also attended several sessions of the convention of the Associated Advertising Clubs of the World at Atlanta and conferred with officials of the Association and with public utility advertising representatives with a view to laying the groundwork during the next 12 mo. for the organization of a Public Utilities Advertising Secton of the Associated Advertising Clubs of the World at its 1922 convention in Milwaukee.

ELECTRICAL STANDARDS DISCUSSED AT QUEBEC CONVENTION.

Manufacture and Testing of High-Tension Porcelain Insulators Among Subjects Considered by Canadian Electrical Association.

The 31st annual convention of the Canadian Electrical Association held recently in Quebec was featured by the following addresses and papers: "Electrical Standards and Their Application to Trade and Commerce," by O. Higman, director of the Electrical Standards Laboratory, Ottawa; "The Consulting Engineer and the Power Company," by J. M. Robertson, consulting engineer, Montreal; "Electrons," by W. B. Cartmel, Northern Electric Co., Quebec; "Modern Street Lighting," by A. B. Cooper, Canadian General Electric Co., Toronto; "Switching Equipment," by L. B. Chubbuck, Canadian Westinghouse Co., Hamilton, and "The Manufacture and Testing of High-Tension Porcelain Insulators," by A. D. Allen, A. D. Allen Inspection Co., Hamilton.

Milan R. Bump, New York City, president of the National Electric Light Association; W. L. Goodwin, general manager of the Society for Electrical Development, New York City, and Samuel A. Chase, special representative of the Westinghouse Electric & Manufacturing Co., were the principal speakers at the annual dinner of the Association.

The election of officers resulted as follows: President, Julian C. Smith, Shawinigan Water & Power Co., Montreal; first vice-president, P. T. Davies, Southern Canada Power Co., Montreal; second vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Co., Quebec; third vice-president, L. W. Pratt, Hamilton Cataract Light & Traction Co., Hamilton; secretary-treasurer, Eugene Vinet, Power building, Montreal. The executive committee consists of the officers in addition to the following: C. T. Barnes, Toronto & Niagara Power Co.; R. J. Beaumont, Shawinigan Water & Power Co.; A. Monro Grier, Canadian Niagara Power Co.; A. A. Dion, Ottawa Electric Co.; W. L. Weston, Nova Scotia Tramways & Power Co.; N. S. Braden, Canadian Westinghouse Co.; J. W. Pilcher, Canadian General Electric Co.; M. K. Pike, Northern Electric Co.; D. H. McDougall, Toronto Power Co.; J. S. Norris, Montreal Light, Heat & Power Consolidated, and J. B. Woodyatt, Southern Canada Power Co.

The Electrical Co-operative Association, Province of Quebec, held its meeting jointly with the Canadian Electrical Association and entertained the delegates with a "smoking concert." Among the speakers were K. B. Thornton, president of the Electrical Co-operative Association; W. L. Goodwin and S. A. Chase.

VARIOUS SECTIONS OF A. M. E. S. DISCUSS PROBLEMS.

Sectional Meetings Well Attended—Radio Demonstration Features Gathering—Gage Golf Cup Won by Chicago Man.

The summer meetings of the various sections belonging to the Associated Manufacturers of Electrical Supplies were held at the Griswold hotel, New London, Conn., June 27-30. The attendance of delegates exceeded 250, the largest in membership since the Association was formed.

The program as carried out was as follows:

On Monday, June 27, subcommittees of the General Standards Committee, General Standards Committee, Wire and Cable Section, Weatherproof Wire Group and the Magnet Wire Group held meetings. On Tuesday, June 28, meetings were held by the Heating Appliance Section, Signaling Apparatus Section, Fuse Section, Snap Switch Section, Lamp Receptacle and Socket Section, Attachment Plug Section, Armored Conductor Section, Nonmetallic Flexible Conduit Section, Metal Molding Section and the Rigid Conduit Section.

A dinner dance, entertainment and a radio demonstration were held on Tuesday evening, and on Wednesday, June 29, the following meetings were held: Panelboard and Switchboard Section, Air Circuit-Breaker Section, Radio Apparatus Section, Industrial Lighting Section, Carbon Section, Knife Switch Section, Molded or Formed Insulation Section and the Line Material Section.

The meeting of the Board of Governors was well attended, the personnel of the Board for 1921-1922 being as follows: S. H. Blake, General Electric Co., Schenectady, N. Y.; F. L. Bishop, Hartford Faience Co., Hartford, Conn.; Le Roy Clark, Safety Insulated Wire & Cable Co., New York City; A. H. Englund, Electric Service Supplies Co., Philadelphia; W. F. Field, Phillips Wire Co., Pawtucket, R. I.; J. J. Gibson, Westinghouse Electric & Manufacturing Co., Pittsburgh; H. D. Hawks, Anaconda Copper Mining Co., Chicago; A. F. Hills, Crouse-Hinds Co., Syracuse, N. Y.; Robert Kuhn, American

Electric Heater Co., Detroit; Shiras Morris, Hart & Hegeman Manufacturing Co., Hartford, Conn.; J. W. Perry, H. W. Johns-Manville Co., New York City; W. C. Robinson, National Metal Molding Co., Pittsburgh; Warren Ripple, George Cutter Works of the Westinghouse Electric & Manufacturing Co., South Bend, Ind.; W. H. Thornley, Tubular Woven Fabric Co., Pawtucket, R. I., and J. H. Trumbull, Trumbull Electric Manufacturing Co., Plainville, Conn.

The sectional meetings also were well attended and much progress reported in nearly every case. The details of what was done will be announced at a later date, as soon as General-Secretary Charles E. Dustin can compile the appropriate form from the proceedings of the numerous important sessions.

On Thursday, June 30, some additional and adjourned meetings were held and quite a number of the visiting electrical manufacturers who were present with their families decided to continue at The Griswold throughout the week and over July 4.

The radio demonstrations were quite interesting and successful and were a decided addition to the program.

The officers of the Associated Manufacturers of Electrical Supplies are the following named gentlemen and the general headquarters are at 30 East 42d street, New York City: President, Shiras Morris, Hartford, Conn.; vice-president, William H. Thornley, Providence, R. I.; treasurer, J. W. Perry, 296 Madison avenue, New York City; general secretary, Charles E. Dustin, and counsel, Thomas M. Debevoise, 62 Cedar street, New York City.

In the golf tournament the "Gage Trophy"—a handsome silver cup suitably inscribed—was won by H. D. Hawks, Anaconda Copper Mining Co., Chicago, who beat George E. Maguire, E. H. Freeman & Co., Trenton, N. J., in playing off the tie of the previous day on Wednesday forenoon.

WATER POWER INTERESTS DISCUSS SITUATION IN THE EAST.

Prominent Water Power Men and Conservation Experts Attend Conference—Legislation Committee of Ten Appointed to Study Situation.

While the attendance at the 2-days' Manufacturers' Power Conference called by the Water Power League and held in New York City June 21-22, was not large, there were prominent water power men and power company representatives present and at the conclusion of the conference it was the opinion of those in a position to judge that the water power men and conservation experts are nearer to an agreement than at any time since the controversy started.

At the Tuesday morning session after the Hon. George J. Gillespie, president of the Board of Water Supply, New York City, had made an address of welcome, Charles T. Root, vice-president of the Water Power League, said: "It is our duty to get to work at once to develop our country and improve its tremendous opportunity. To do that we must be able to furnish American manufacturers with an unending supply of power that will enable them to compete with the manufacturers of other countries. Our natural resources exceed those of any other country on earth, but because of the very lavishness with which nature has blessed us we have wasted them to the point of approaching extinction. We can atone to ourselves and our posterity only by immediate development and utilization of our water power."

Mr. Root speaking officially for the Water Power League stated that the League was prepared to co-operate in obtaining a plan for (1) an inventory of the national water resources; (2) the establishment of a systematic and thorough national policy for their utilization, and (3) insuring continuity of plan and administration.

The League also favors the creation of a permanent commission which would function as a licensing body only in aiding the development of all our water resources, but unless private capital is given an absolute guarantee of safety it will not go into water power development. The repeal of the Federal Power Act and the General Dam Act of 1910 was advocated, and thereby automatically return to the War Department the authority it used to have over the streams of the country and under which all the water power development in this country, or most of it was effected, and allow development to go ahead immediately.

Then followed a paper by O. C. Merrill, executive secretary of the Federal Power Commission, which discussed the rules, regulations and procedure of the Federal Power Commission, with particular reference to the relation of Federal to State authority.

In the afternoon T. Kennard Thomson, consulting engineer, analyzed the electric power situation in both New York City and state and termed the notion that the power development of Niagara is unlimited as fallacious, since New York state alone uses more power than Niagara could supply. In conclusion he outlined a plan to utilize the power of the Niagara river without marring its scenic beauty, by damming it 4 mi. below the Falls.

On Wednesday E. T. Stanfield, vice-president of the Arkansas Hydro-Electric Development Co., presented his paper on "Financing Water Power Projects" wherein he described the methods followed in developing the power resources of Arkansas. He said: "After ascertaining the rainfall, runoff, variations of stream flow and the like, we make a careful survey and determine the logical points to place the dams so that sufficient pondage or reservoir space will be secured to conserve the surplus flow of the stream during the dry or low water period and thus regulate the stream flow throughout the year. When the tributaries are harnessed in this manner the stream flow of the larger streams is controlled so that a series of low dams can be placed on them without flooding the more valuable lands, conserving potential power, producing dependable navigation, eliminating levies and making feasible the drainage of swamp land."

"Realizing the unlimited natural resources of our water power and the large deposits of other natural resources such as bauxite, lead, zinc, manganese, phosphate, limestone, marl and many others we found the utilization of water power to be the solution for the development of the state. Our plan now is to finance the first unit of devel-

opment by common and preferred stock owned and controlled by Arkansas citizens. We are all investors and no stock is sold for less than par, while all necessary permits, grants and franchises have been given by the state."

After discussion and criticism of legislation restricting the development of water power, the following committee was appointed: T. Chalkley Palmer, vice-president of the American Dyewood Co., Chester, Pa., chairman; Dr. C. A. Ernst, president of The Viscose Co., Marcus Hook, Pa.; Paul T. Brady, Westinghouse Electric & Manufacturing Co., 165 Broadway, New York City; George S. Shimer, president of the Milton Manufacturing Co., Milton, Pa.; George L. Finch, superintendent of the Hood Rubber Co., Watertown, Mass.; T. Kennard Thomson, consulting engineer, 50 Church street, New York City; George C. Danforth, chief engineer of the Maine Water Power Commission, Augusta, Me.; F. A. Forgee, consulting engineer, 141 East 29th street, New York City; Ben A. Hapgood, industrial secretary of the Springfield (Mass.) Chamber of Commerce, and Sen. J. T. Newcomb, chief counsel of the Electric Bond & Share Co., 71 Broadway, New York City.

This committee will work during the summer studying the situation and conferring with all interests involved, and endeavor to prepare a suggestive amendment to the Federal Power Act that will make it workable and secure more moderate interpretation of the law.

EDISON SPENDS BUSY DAY IN NEW YORK CITY.

Noted Inventor Inspects Many Features of Electrical Development of Metropolis—Visits Hell Gate Plant and Ventilation Show.

In a trip that took him through Brooklyn, Manhattan, and the Bronx, Thomas A. Edison recently inspected many features of the electrical development of the city. He was the guest of the officials of the various electric light and power companies which now serve Greater New York. Mr. Edison's first stop was in the financial district where he visited the offices of N. F. Brady, president, and Thomas E. Murray, vice-president of The New York Edison Co. From Wall Street the party went to the factory of the Metropolitan Engineering Co. in Brooklyn to study the manufacture of protective devices used by the power companies. A feature of the engineering company's plant was the electric welding department. It was said that if this equipment was used to capacity in one day enought axle housings could be welded to supply the demand of the world.

After luncheon at the Crescent Club they left for the Bronx where the new Hell Gate power station of the United Electric Light & Power Co. is being built. Mr. Edison made a thorough inspection of the huge building and was particularly interested in the progress of the concrete work, the plans for the intake tunnels, and the arrangements for the big steam turbines and the generators. There was a certain amount of sentimental interest in the inventor's visit to the power plant for it was just 40 yrs. ago that he was engaged in the construction of his own plant at 257 Pearl street. This plant began operation in the following year and marked the beginning of New York's present electrical system.

From the Bronx the electrical party returned to Manhattan and stopped at the Irving place office of the Edison company where an electrical ventilation show was in progress. After being thoroughly cooled off by the 12-ft. electric fan and invigorated by the inhalation of electrically washed air, Mr. Edison called it a day and returned to Orange.

Among those who escorted Mr. Edison on his trip were N. F. Brady, president, Thomas E. Murray, vice president, John W. Lieb, vice-president, Walter Neumuller, secretary, and Arthur Williams, general commercial manager of the New York Edison Co.; Frank W. Smith, vice-president of the United Electric Light & Power Co.; M. S. Sloan, president of the Brooklyn Edison Co.; Thomas E. Murray, Jr., president, and Joseph B. Murray, vice-president of the Metropolitan Engineering Co., Walter H. Chrystler, automobile engineer; W. H. Meadowcroft, Mr. Edison's assistant, and James C. Brady.

PLAN CONFERENCE OF INDUSTRIAL ADVERTISING INTERESTS.

The Engineering Advertisers' Association of Chicago and the Technical Publicity Association of New York form the nucleus of the movement in which all industrial advertising interests will be invited to join. Keith J. Evans, president of the first-named organization, and W. A. Wolfe, president of the New York Association, are planning to call special meetings in the near future to take official action on the ideas developed at the Atlanta convention of the Associated Advertising Clubs.

It was the unanimous opinion of those present at the meeting held after the departmental session of the Associated Business Papers, that more attention should be given to industrial advertising and that definite plans should be made to put on an attractive program in Milwaukee in 1922.

A. M. OF E. S. HOLDS MEETING IN CHICAGO.

Outlet Box Section Divided Into Four Sections to Facilitate Action of Various Interested Representatives in the Section.

A meeting of the Outlet Box Section of the Associated Manufacturers of Electrical Supplies was recently held in Chicago, at which it was voted, for the purpose of facilitating action of the various interested representatives in the Outlet Box Section, to divide the section into four, as follows: (1) Outlet Box Section; (2) Switch Box Section; (3) Outlet Box Fitting Section, and (4) Cast Box Section. Only actual manufacturers of products involved will be eligible to the Outlet Box Section, the term "manufacturers" to mean only companies who have invested in plant, tools and machinery to produce the said products.

The officers of the Outlet Box Section are: G. H. Sicard, Pratt-Chuck Co., Frankfort, N. Y., chairman; H. G. Knoderer, Sprague Electric Works of General Electric Co., New York City,

secretary, and H. D. Betts, Thomas & Betts Co., New York City, treasurer.

R. P. Harrison, Thomas & Betts Co., was elected chairman of the Cast Box Section and H. G. Knoderer, secretary.

Outlet Box Fittings Section officers are: R. P. Harrison, Thomas & Betts Co., New York City, chairman, and C. Renshaw, National Metal Molding Co., Pittsburgh, secretary.

The officers of the Switch Box Section are: F. K. Merrill, Appleton Electric Co., Chicago, chairman, and C. Renshaw, National Metal Molding Co., Pittsburgh, secretary.

A. I. E. E. STANDARDS SUBMITTED FOR APPROVAL.

The American Institute of Electrical Engineers has submitted its Standards (1921 edition) to the American Engineering Standards Committee for approval as an American standard. The Standards are submitted in accordance with the special provision in the procedure of the committee under which important standards adopted or in process prior to 1920 may be approved without going through the regular process followed in new work. The standards submitted represent the latest revision of the American Institute of Electrical Engineers' standardization rules, revised during 1919 and 1920. The first edition of the rules was issued in 1899.

The American Engineering Standards Committee would be very glad to learn from those interested of the extent to which they make use of these specifications and to receive any other information regarding the specifications in meeting the needs of the industry. The Standards of the American Institute of Electrical Engineers are issued in a 172-page book in flexible cloth binding. Copies may be obtained from the American Engineering Standards Committee, 29 West 39th street, New York City, at $2 each.

PAGEANT OF PROGRESS PLANS ARE NEAR COMPLETION.

All Available Space for Exhibits Now Sold, With Continued Increasing Demands Being Made by Various Manufacturers.

The Municipal Pier, Chicago, the largest of its kind in the whole world, is rapidly nearing the day—July 1, a month before the exposition opens—when all of the booths will be finished, decorated and ready for the installation of the 3.5 mi. of interesting exhibits, space for which has already been contracted.

At a luncheon given in the pier restaurant, June 22, by Mayor Wm. Hale Thompson to about 75 of Chicago's leading business men, among whom were the managers of the 16 divisions into which the exhibit space has been divided, reports from these managers showed that every available foot of space had been sold and that tardy manufacturers were now clamoring for a chance to get in. The mayor stated that the situation is one which cannot be remedied this year, but that plans are now being seriously considered which contemplate the roofing over of the area between the two headhouses for next season. This would more than double the space now available and would probably be ample for a long time to come.

There are many interesting operative exhibits planned by the manufacturers who have secured space, and the Electrical Division will be particularly impressive. Visitors to the Pageant of Progress will go back to their homes, after having visited this wonderful show, with the satisfaction of having added much to their general knowledge of our national progress.

As an indication of the great amount of publicity which the Pageant of Progress has had, and that which is still to come, the mayor stated that many clippings from publications in Europe and South America referring to this great exposition had reached his office. The enterprise could no longer be considered of a local character, or even national, as these evidences clearly indicated international interest. On Thursday, June 23, through the enterprise of Tom Hay, manager of the automotive division, 50 touring cars left Chicago for outlying districts within 200 mi. conveying the personal invitation of the mayor and the city council to the municipal officers of the places visited to attend the Pageant of Progress.

As an indication of the attention to detail which Mayor Thompson has given this show, he stated that a lease had been secured upon every vacant lot south of Chicago avenue, and these will be graded and put in shape for the parking of visiting tourists.

Well made and substantial frames with hinged glass covers are to be installed in 1000 railway stations along lines entering Chicago. These will contain beautifully lithographed posters which will be changed frequently and will carry the message of the Pageant of Progress to every state in the Middle West. The Pageant opens to the public on July 30 and closes Aug. 14.

STANDARDS RECENTLY APPROVED BY THE A. E. S. C.

Standards recently approved by the American Engineering Standards Committee include four copper specifications submitted by the American Society for Testing Materials as "Tentative American Standard," as follows: 9-1921, soft or annealed copper wire; 10-1921, lake copper wire, bars, cakes, slabs, billets, ingots, and ingot bars; 11-1921, electrolytic copper wire bars, cakes, slabs, billets, ingots, and ingot bars, and 12-1921, battery assay of copper.

DEMONSTRATE ELECTRICITY AS A SOURCE OF HEAT.

Exhibit of Electrical Apparatus in New York City Includes Many Interesting Devices for Industrial and Domestic Use.

The various applications of electricity as a source of heat were interestingly exhibited and demonstrated at the electric heat show held by the New York Edison Co. in its display rooms at 15th street and Irving place, New York City, during the week of June 6. Ranges, ovens, table appliances, flatirons, soldering and branding irons, heaters, glue pots, etc., were among the apparatus displayed by the exhibitors, which numbered over 40. While the larger number of the devices displayed were for industrial or commercial pur-

poses, there were just enough others for domestic use to interest the housekeeper and therefore there was a good attendance both of the general public and commercial and industrial men.

Electric ranges of all sizes were exhibited by Bramhall, Deane Co., Duparquet, Huot & Moneuse Co., Hughes Electric Heating Co., Landers, Frary & Clark, Rutenber Electric Co., Simplex Electric Heating Co., Standard Electric Stove Co. and the Western Electric Co., while in addition to the large Westinghouse bake oven for the commercial baking of bread, cake, pies and pastry, other sizes were shown by Duparquet, Huot & Moneuse Co., Jaburg Bros. and the Simplex Electric Heating Co.

The Waage Electric Co. featured a 4-heat electric flatiron and other exhibitors of flatirons were the American Electric Heater Co., Simplex Electric Heating Co. and the Western Electric Co. The Prometheus Electric Co. displayed electrically heated ring heaters, hot plates and special forms, and the "Sepco" automatic water heater made by the Automatic Electric Heater Co. was shown in actual service.

Among the other exhibitors were the Aqua Water Heater Co. (instantaneous hot water heater); Cutler-Hammer Manufacturing Co. (controlling devices); Mergenthaler Linotype Co. (type melting pot); Detroit Electric Branding Iron Co.; General Electric Co. (industrial heating devices); Edison Electric Co. (table appliances); Hoskins Manufacturing Co. (Chromel resistor alloys); M. Kirchberger & Co. (Lavarock insulation); Manning, Bowman & Co. (table appliances); Reimers Electric Appliance Co.; Vulcan Electric Heating Co. (soldering iron); American Insulator Co. (insulation connector material); Johns-Manville Co., Inc. (asbestos material); Electrical Alloy Co. (resistance wires), and the International Electric Co. (glue pots).

NEW ENGLAND PUBLICITY BUREAU ORGANIZED.

Following the example of Illinois, Oklahoma and about 10 other states, officials of public utilities of the New England states have taken the initial steps to organize a bureau of public utility information. The headquarters of this bureau will be in Boston and its functions will be to make available to the people, through the newspapers, accurate news as to all phases of public utility activities and to combat misinformation.

The public utilities of Oklahoma, through the Oklahoma Utilities Association, have maintained a news bureau of this kind with headquarters at Oklahoma City, since last November. Among other states having such bureaus are Illinois, Wisconsin, Indiana, Ohio, Nebraska, Iowa, Missouri, Kentucky and Michigan. Similar bureaus are now being organized in Georgia and Alabama.

SECTIONAL COMMITTEES RECENTLY DESIGNATED BY A. E. S. C.

In compliance with the request of the American Institute of Electrical Engineers the American Engineering Standards Committee has designated the American Institute of Electrical Engineers sponsor for the formation of a sectional committee on "Standard of Aluminum for Conducting Purposes." In conformity with the request of a conference of interested national organizations, the Engineering Standards Committee has designated the American Institute of Architects, the American Institute of Electrical Engineers, and the National Association of Electrical Contractors and Dealers, joint sponsors for a sectional committee on Symbols for Electrical Equipment of Buildings and Ships.

Upon recommendation of its General Correlating Committee for Mining Standardization, the American Engineering Standards Committee has authorized the organization of sectional committees on "Safety Rules for Installing and Using Electric Equipment in Bituminous Coal Mines," "Portable Electric Mine Lamps," and "Storage Battery Locomotives for Use in Gaseous Mines." The U. S. Bureau of Mines has been designated as sponsor for each of these sectional committees.

ELECTRICAL EXPOSITION PLANNED AT TULSA, OKLA.

Tulsa, Okla., is making extensive preparations for the electrical exposition to be staged there Oct. 17-22. Electrical dealers of Tulsa declare that more than 150 novel electrical displays will be made. These will include a reproduction of Niagara Falls, a California bungalow completely equipped with all electrical devices for the home, and a demonstration of milking cows by electricity. The Public Service Co. of Oklahoma and the Sand Springs Light & Power Co. have made arrangements for displays at the exposition.

COMING CONVENTIONS.

Wisconsin State Association of Electrical Contractors and Dealers. Summer outing and business meeting, Waupaca, Wis., July 9-11. Secretary, H. M. Northrup, 23 Erie street, Milwaukee.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 12-15. Headquarters, Breaker's Hotel. Secretary, D. L. Gaskill, Greenville, O.

National Association of Electrical Contractors and Dealers. Anniversary convention, Buffalo, N. Y., July 18-23. Headquarters, Lafayette Hotel. Secretary, W. H. Morton, 110 West 40th street, New York City.

Pennsylvania State Association of Electrical Contractors and Dealers. Semi-annual meeting, Buffalo, N. Y., July 19. Headquarters, Lafayette Hotel. Secretary, M. G. Sellers, 1518 Sansom street, Philadelphia.

Michigan Electric Light Association. Annual convention, Ottawa Beach, Mich., Aug. 24-25. Headquarters, Hotel Ottawa. Secretary, Herbert Silvester, Ann Arbor, Mich.

New England Geographic Division of the National Electric Light Association. Annual convention, New London, Conn., Sept. 6-9. Headquarters, Hotel Griswold. Secretary, Miss O. A. Bursiel, 149 Tremont street, Boston.

Association of Iron and Steel Electrical Engineers. Fifteenth annual convention, Chicago, Sept. 19-24. Headquarters, Hotel La Salle. Secretary, John F. Kelly, Empire building, Pittsburgh.

Illuminating Engineering Society. Annual convention, Rochester, N. Y., Sept. 26-30. General secretary, Clarence L. Law, 29 West 39th street, New York City.

New York Electrical Show, 71st Regiment Armory, Park avenue and 34th street, New York City, Sept. 28-Oct. 8. General manager, George F. Parker, 124 West 42d street, New York City.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

AUTOMATIC PROTECTION OF STREET LIGHTING CIRCUIT.

Simple Device Employed to Minimize Effects of Grounds and Short-Circuits on Street Systems.

By J. H. ROBERTSON,
Manager, North Carolina Public Service Co., Salisbury, N. C.

An installation which will prove interesting to readers of ELECTRICAL REVIEW and at the same time be the means of a large saving in lamps, if tried, is in operation at a substation of the North Carolina Public Service Co. at Salisbury, N. C. The necessity for this installation was brought about by the burning out of street series lamps on one of the circuits controlled from this station, the circuit in question containing about 15 mi. of No. 6 wire feeding twenty 100-cp., forty-one 80-cp. and fifty-six 60-cp. incandescent 6.6-ampere street series lamps. No arc lamps are on this circuit. The station equipment consists of a regulator rated at 25 lights (meaning arc lamps) and a switchboard as shown in the accompanying diagram.

On one occasion a cross with a secondary of a lighting transformer occurred at the point *A* in the diagram, and every lamp on the circuit from

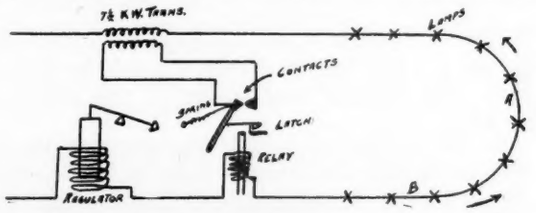


Diagram of Lighting Circuit With Relay and Reactance in Place.

A back to the station in the direction shown by the arrow was burned out. On another occasion a cross occurred at *B* with the same result, the lamps from *B* back to the station in the direction of the arrow being burned out.

LAMPS BURNED OUT ON ACCOUNT OF ACCIDENTAL GROUNDS.

An analysis of the existing conditions showed that if this trouble was to be avoided in the future it was necessary to arrange to insert some high reactance in the line at the station in case of a cross or ground, whereas under normal operation this reactance would be cut out. It was decided to use a 7.5-kw. transformer rated at 2300 volts primary and 350 volts secondary. Recognizing the fact that the reactance of the primary of a transformer is high with the secondary open and low with a short-circuited secondary, the transformer was installed with the primary in series with the arc line and the secondary wires connected to the contact points of a home-made relay. This relay consists of a pull-up coil which is connected directly in the arc line, an armature, and two contact points to which are connected the secondary leads of the transformer.

Under normal current, which is 6.6 amperes, the armature of the pull-up coil floats within the coil, guide rods having been arranged to hold it in place. With a sudden increase of current, say to 7 amperes, this armature is quickly pulled up tripping a latch which holds the contact points together and allowing the contacts to be separated by a spring, opening the secondary of the transformer and automatically inserting the high reactance of the primary in the arc line and thereby reducing the current to approximately 1 ampere. When this happens the operator at the substation tries the line a second and third time and if the trouble still exists the trouble department is notified. The contacts have to be closed by hand, of course, this insuring that the operator knows of any trouble.

In order to satisfy ourselves that the apparatus would take care of an extreme condition the following test was made: With the circuit operating under normal conditions with approximately 1600 volts on the arc line, the entire external circuit, with the exception of two lamps which operate normally on about 64 volts, was shunted out, throwing the voltage of the entire circuit on these two lamps. The relay operated so quickly that these two lamps were not damaged in any way.

The credit for the design of this piece of apparatus should be given to F. L. Bunker of the Charlotte, N. C., branch of the Westinghouse Electric & Manufacturing Co. We have experienced no trouble from burned-out lamps since the installation of this relay.

CONSTRUCTION FEATURES OF POWER PROJECT IN AUSTRALIA.

Pressure of 132,000 Volts to Be Used With Duplicate Circuit 112 Mi. Long—Ultimate Capacity of 125,000 Kw. Planned.

Plans are now complete and tenders have been invited in connection with an electric power project of considerable magnitude in Australia. This development is on a par with some of the largest undertakings in this country and includes items of considerable general interest.

The power station, to be erected at the coal fields 112 mi. from Melbourne, will have an ultimate capacity of 125,000 kw. As usual in connection with large coal-burning stations the question of water supply for condensing purposes is a most important one, and although the power house will be erected alongside a river, it will be necessary to provide spray-cooling ponds in addi-

tion. The generating plant will consist of five units, each of 25,000-kw. capacity.

An interesting feature of this project is the adoption of outdoor transformer and switching equipment along the lines of what appears to be the present trend in this country. Transmission will be at 132,000 volts and 50 cycles, the generators being wound for 11,000 volts at the terminals. Single-phase transformers of 9260 kv-a. capacity will step up the pressure for transmission to the substations.

Unusual Features in Connection With Transmission Line Construction.

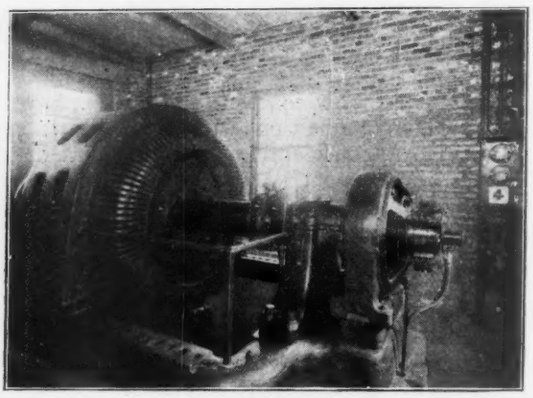
A somewhat unusual feature of the transmission line is the great length of the average span. The distance between towers will be from 1050 to 1500 ft., which is in excess of what is generally found to be an economical span in American practice. The large spacing has been adopted in order to reduce as far as possible the number of insulators. The main transmission will consist of two 2-circuit steel-tower lines, each circuit consisting of three conductors hung vertically one above the other with a spacing of 11 ft. between wires. Each insulator string will consist of seven units, except at dead-ends where eight units will be used. An overhead ground wire will be strung between towers above the conductors, and the telephone line will be run on separate poles. The economical capacity of each main transmission line will be 25,000 kw. Synchronous condensers will be used for voltage and power-factor control, each substation being equipped with two such machines of 15,000-kv-a. capacity.

Distribution in Melbourne will be by underground cables at 22,000 volts. It is estimated that about 80 mi. of high-tension underground cable will be required.

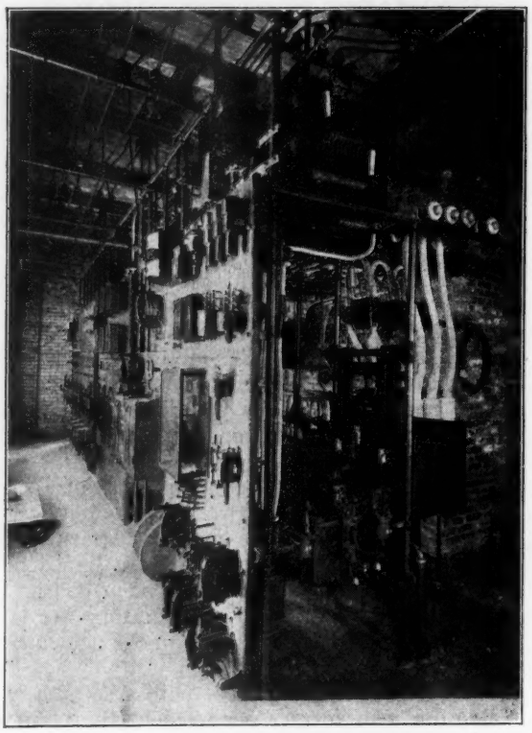
AUTOMATIC-OPERATED SYNCHRONOUS CONDENSER EQUIPMENT.

Successful Operation for Four Years Indicates Practical Utility of Automatic Machinery for Power-Factor Control.

A synchronous condenser that has two special claims to interest is at present operating at the Hazel Green, Wis., station of the Interstate Light & Heat Co. It is believed to be the first synchronous condenser entire operation, starting, stopping and regulation of which is entirely automatic, and it has been operating successfully and continuously for 4 yrs. According to recent reports received from the plant its effect on the power-factor, and consequently on the fuel consumption at the main plant, is distinctly noticeable. Once when it was shut down for inspection the firemen at the power plant complained about being forced to shovel so much more coal.



3000 Kv-A. Synchronous Condenser Installed at Hazel Green, Wis.



Control Board in Station at Hazel Green, Wis.

They said that if the condenser remained off the line for any length of time it would be necessary to add another coal passer to the boiler-room force.

The condenser, which was made by the General Electric Co., Schenectady, N. Y., is rated at 3000 kv-a. and is operated at 2300/4000 volts. The station where it is located is in a mountainous and more or less inaccessible country where trained operators are hard to get. As a matter of fact, most of the personnel are quite unfamiliar with the operation of electical apparatus. This makes the successful operation of the condenser for such a long period even more notable.

Automatic condensers have a wide range of application. They may be installed anywhere on a system to compensate for the wattless component of a low-power-factor load, and maintain practically constant voltage. This automatic control makes them free from such considerations as accessibility of location, and the simplicity of the control system is such as to not require a force of trained operators to insure its correct performance. Even the men to be found on a small system are able to keep it in good operating condition.

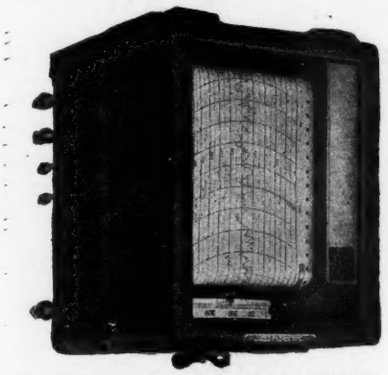
The offices of the Illinois Committee on Public Utility Information have been moved to rooms 339-341, 122 South Michigan avenue, Chicago.

APPLIANCES and DEVELOPMENTS

New, Improved or Interesting Electrical and Mechanical Apparatus and Devices, and Applications of Equipment and Methods in Practice

Esterline Graphic Demand Meter Recording Kv-A.

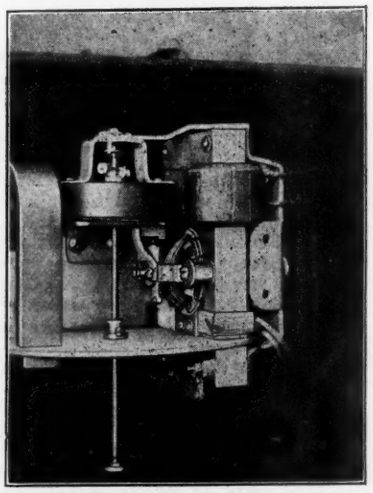
It is generally recognized that the cost of serving a power customer is affected by the power-factor of his load, and rates are now being put into effect which take power-factor into account. The insistent demand for a



Esterline Graphic Kv-A. Meter With Case Closed.

kv-a. meter has arisen from the fact that it is in many cases the "investment" or "readiness-to-serve" cost which is affected by power conditions, so that the demand charge should be based on the customer's maximum demand measured in kilovolt-amperes. The kv-a. meter makes this possible.

On account of the great demand for a kv-a. measuring instrument practically all electrical instrument manufacturers have been working on this prob-



Interior View of Esterline Kv-A. Graphic Demand Meter.

lem, and the Esterline-Angus Co., Indianapolis, Ind., has now announced that it has succeeded in producing a simple and practicable instrument which is being placed on the market.

This instrument is of the induction type and can be made in the graphic, integrating, indicating and interval-demand type. The graphic type instrument has been developed first. The measuring element is shown in an accompanying illustration. Each single-phase element consists of a pair of laminated poles carrying exciting windings, between which is pivoted a small armature which maintains a fixed phase relation between the magnetic field produced by the current winding and the field produced by voltage windings.

The scale is uniformly divided throughout; the instrument is equally accurate throughout the entire range of power-factor from unity to zero, either leading or lagging. The meter records the true kv-a. of the circuit regardless of the degree of unbalance, according to the statement made by the manufacturer. The 3-phase instrument indicates the sum of the products of current per phase times the corresponding voltage to neutral, which is the true kv-a. of a 3-phase circuit. The accuracy of the instrument is within the established limits for electric meters, regardless of commercial variations in voltage, frequency and wave form. Meters of this type have been fully developed in the portable, switchboard and wall types, and are now in production for delivery early in July.

"Laun-Dry-Ette" Users' Book Contest Announced.

The Laundryette Manufacturing Co., 1190 East 152d street, Cleveland, has announced through its advertising and selling organ known as "The DRYer," a "Laun-Dry-Ette" users' book contest. The competition will take place among "Laun-Dry-Ette" distributors and dealers and their salesmen. No direct employe of the Laundryette Manufacturing Co. will be eligible. The contest was originally planned to last from June 1 to Aug. 1, but has been extended to Aug. 15. This was due to the delay in making the announcement occasioned by the printers' strike. Each "Laun-Dry-Ette" man is asked to enter the competition by preparing and submitting a scrapbook of testimonial letters from "Laun-Dry-Ette" users.

Receiver Type Steam Separators For Use With Engines.

Engineers in general are becoming more convinced of the fact that it is not only essential to have an efficient steam separator installed in the main steam line in a plant, but it is also important that this separator shall be so built that it has a large storage capacity. This storage or receiver capacity is necessary for two reasons: First, in case a slug of water comes over from a priming boiler it is necessary to have this large receiver space to prevent this slug of water from going into the engine. Secondly, a large steam receiver space insures that the engine will receive a constant steam pressure.

The accompanying illustration shows the Stratton separator, receiver type, having a castiron or steel head and a body of boiler plate, so designed as to have a large cubical content and thus comply with the requirements as speci-

Stratton Steam Separator.

fied above. The separator is designed to remove water from the steam by the utilization of centrifugal force. As the water and steam enter the separator they pass through a helical path, which results in a swirling motion of the entire mass. As water is several hundred times heavier than steam it is thrown out of the curving steam current against the wall of the separator, which it meets at an angle without any spatter or splash, and continues on its way until it reaches the receiver space at the bottom. Here properly designed baffles check the motion and permit the drainage of the accumulated water. The Stratton steam separator is manufactured by the Griscom-Russell Co., 90 West street, New York City, and is described in bulletin No. 1140.

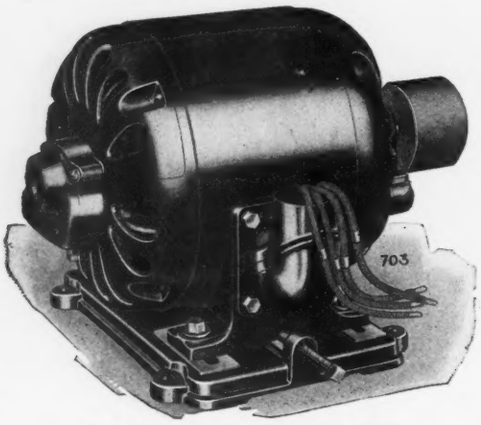
New Type of Repulsion Induction Motor.

A new single-phase motor of the repulsion start, induction type has recently been put into production by The Robbins & Myers Co., Springfield, O. This motor is furnished for services which require high-starting torque with low-starting current. The motor starts as a repulsion motor. At full speed a centrifugal device operates, short circuiting each commutator bar and lifting the brushes from the commutator, protecting the brushes and commutator from unnecessary wear. The action of this device is positive and does not depend upon the end play of the armature to push the brushes from the commutator.

The interior of the motor is protected

by ventilated inclosing end heads, a removable cover being provided on the commutator end for inspection of the commutator and brushes. The end head at the commutator end is marked for the three positions of the brush rocker arm which gives clockwise and counter-clockwise rotation and neutral.

Oil ring lubrication is used. The oil reservoirs are large and fitted with over-



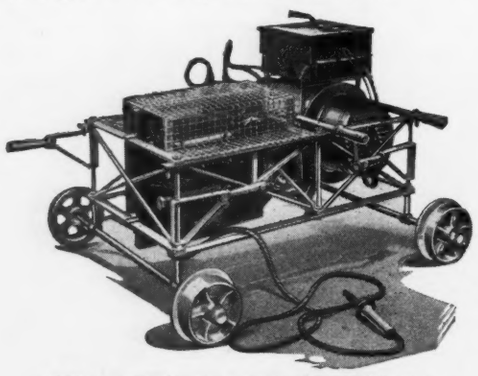
R & M Type "R" 0.5 hp. Motor.

flow gauge. By turning the end heads the motors can be adapted for side wall or ceiling mounting. When this is done the brushes of 2 and 6-pole motors must be shifted to correspond to the new position of the end heads.

The average starting torque from rest is 350% full load torque and the average starting current is 300% of full-load current. The motor will bring up to normal speed a load of 1.25 to 1.75 normal full load. The maximum running torque is over 200% of full load torque. This motor, known as R & M Type "R" is at present furnished in 0.5 hp. size only, but other sizes ranging from 0.25 to 1 hp. will soon be in regular production.

New Machine for Rail Bonding and Track Work.

A new electric arc-welding machine, especially intended for rail bonding and track work, has been brought out by the Wilson Welder & Metals Co. The machine was designed at the request of The Ohio Brass Co., which acts as sole



Wilson Plastic-Arc Rail Bond Welder.

selling agent. Fundamental in the Wilson plastic-arc rail bond welder is uniform heat per unit area in the weld. This is accomplished by means of a short arc and automatically controlled current.

It is generally conceded that the best electric welds are made with a short arc. That is because the heat is localized, the metal flow is well controlled and the weld is never burned or hard. With the Wilson machine the potential across the arc is only 18 volts. It is impossible to hold a long arc and when the operator has picked up the knack of short arc welding, which is not a hard matter, he produces good welds.

Current control is accomplished by a solenoid operating in conjunction with a carbon pile. During welding the regulator automatically maintains the current at a practically constant value regardless of line variations. Short-circuit current is held to about 10% of welding current. Heat is controlled within 4%.

The Wilson plastic-arc rail bond welder is unaffected by line surges. It is a dynamotor using the metallic arc process. It is wound for two voltages. One machine operates on 350 to 650 volts d.-c. and the other on 150 to 350 volts d.-c. Although the machine is specifically designed for rail bonding and track work, as it has been designed for continuous service at full rated welding current, it is also valuable for general repair and shop welding.

Data on Electric Iron Smelting Development.

The Compania Electro Metallurgica Braziliera and the Batcheller-McConnel Co., New York City, have recently acquired from Frank Hodson, president of the Electric Furnace Construction Co., 908 Chestnut street, Philadelphia, and his Swedish associates, the exclusive rights and licenses for the state of Brazil for the Gronwall type "Electrometall" electric shaft smelting furnace. Two large furnaces, each of 3000 kw. capacity, are at present being installed by the Brazilian company, and it is probable a number of others will follow the original installation.

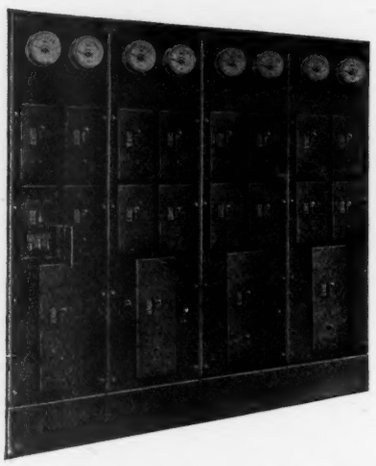
It is stated that these are the first really commercial electric smelters to be erected on the Western Hemisphere, and they undoubtedly mark a new development in the steel trade. In Europe this type of furnace has been in successful operation for some years and of 27 furnaces installed in Sweden, Norway, Italy, Japan, etc., the total power capacity is no less than 99,700 kw. Broadly speaking, the fundamentals which make such a plant feasible are: Presence of fairly good ore and limestone near cheap electric power and the demand of steel and iron. Many parts of the Pacific Coast and some parts of the Adirondacks and New Jersey have these fundamentals.

Frank Hodson, who is closely connected with the development of the "Electrometall" smelting furnace, advises that a large Western corporation will probably put in the first installation in the United States, and further states that several large electric pig-iron smelting installations will be proceeded with shortly.

Switchboard of Dead-Front and Rear Construction.

A radically new type of switchboard, manufactured by the Krantz department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., provides complete safety to the operator. There are no exposed contacts of any kind, either front or rear, nor is it possible for the operator to reach live parts under any circumstances without dismantling part of the board. These boards are suitable for any capacity up to 600 amperes on 250-volt d-c systems, and 1000 amperes on 600-volt a-c systems. They may be equipped with any number of switches, circuit-breakers, meters and other switchboard instruments, and are applicable for hotels, office buildings, theaters, etc.

The board can be made up of any desired number of panels, each of which consists of a heavy sheet-steel front which is finished to resemble slate and is mounted on angle-iron supports with cross beams to make the construction rigid. Openings of the proper size are provided in the front,



Safety Switchboard With Dead Rear and Dead Front.

and into these switches and other instruments are accurately fitted and supported by angle irons in the rear.

Switches are of the Krantz autolock type with all of the safety features retained. Each switch is in a separate compartment and is operated by a handle which projects through the cover, but is always dead. A door gives access to the fuses, but it is interlocked with the switch and cannot be opened unless the switch is in the off position and all accessible parts are dead. The switch cannot be closed while the door is open.

In addition to the fuse door each switch has a cover which is held in place by screws. The removal of this cover gives access to the bus-bar connections and switch mechanism for inspecting the switch contacts, for making load tests of motor circuits without interrupting the service, and for renewing or repairing the switch. All parts are removable from the front. The bus-bar connections are made through studs which connect with the stationary switch contacts. Because of this construction there is little need to go behind the board, and the rear projection is small so that it can be placed very close to the wall.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Decker Electrical Engineering Co., Buffalo, N. Y., has filed notice of dissolution under state laws.

West Virginia Armature Co., Bluefield, W. Va., has filed notice of increase in its capital stock from $50,000 to $250,000.

Home Electric Appliance Co., Pittsburgh, has filed notice of increase in its capital stock from $250,000 to $500,000 for expansion.

Allis-Chalmers Manufacturing Co., Milwaukee, has issued a new bulletin No. 1115 entitled "Alternating-Current Generators, Engine Type."

W. V. Pangborne & Co., 1927 West Montgomery street, Philadelphia, electrical contractors, have taken bids for the erection of an addition to their repair and construction shop.

Manhattan Refrigerating Co., Gansevoort and West streets, New York City, has acquired property at 808-10 Washington street, and is reported to be planning the erection of a plant.

Delta-Star Electric Co., 2433 Fulton street, Chicago, manufacturer of high tension equipment, is distributing special publication No. 55, which is devoted to central station service for farmers.

Jarvis Storage Battery Co., Winston-Salem, N. C., recently organized will operate a local plant for the manufacture of storage batteries and kindred equipment. L. J. and G. C. Jarvis head the company.

Nelson Pulley Co., Inc., 652 77th avenue, West Allis, Wis., was recently organized to manufacture power transmission appliances, etc. The incorporators are C. J. Nelson, L. K. Anderson and Frank Krause.

Continental Electric Co., Ltd., has recently been formed to manufacture and sell "Royal" electric cleaners in Canada. The new organization has its headquarters at 507-511 King street, East, Toronto, Ont.

Carolina Electric & Repair Co., 232 South Davie street, Greensboro, N. C., recently organized with a capital of $25,000, will operate a local electrical construction and repair plant. C. W. Moore and J. J. McDonald head the company.

A. H. Petersen Manufacturing Co., Milwaukee, has announced that it has discontinued its tool and die department and will turn over its entire plant to the manufacture of "Hole Shooter" portable electric drills and other automotive devices.

Pass & Seymour, Inc., Solvay, N. Y., manufacturer of electric wiring devices, has announced that L. L. Parkinson has been appointed Chicago district sales manager to succeed William Hall, Jr. Mr. Parkinson was connected with the Westinghouse Electric & Manufacturing Co. for 15 yrs., and for the past 8 yrs. he was branch manager of the Westinghouse Lamp Co. at Detroit. Mr. Parkinson is the inventor of a number of electrical devices and apparatus, which are in use throughout the world.

John A. Roebling's Sons' Co., Trenton, N. J., manufacturer of wires, cables, etc., has preliminary plans under way for the erection of a 1-story addition to its copper wire and electrical galvanizing plant on Lalor street, 500 by 850 ft., estimated to cost $150,000.

Triumph Electric Co., Cincinnati, manufacturer of "Triumph" motors and generators has announced that its New York office, of which T. W. Kloman is manager, has been moved from 80 Courtlandt street to the Knickerbocker building, at 42d street and Broadway.

Wood & Lane Co., the St. Louis representative of the Triumph Electric Co., Cincinnati, manufacturer of motors and generators, has moved its offices from 915 Olive street to 1016 Market street, St. Louis, where large warehouse facilities have been provided for handling the various lines.

Standard Underground Cable Co., Washington street, Perth Amboy, N. J., manufacturer of electrical wires and cables, etc., has preliminary plans under way for the erection of an addition to its local plant, including a number of 1-story extensions to provide about 100,000 sq. ft. additional floor area. The expansion is estimated to cost in excess of $200,000.

Triangle Conduit Co., Inc., 50 Columbia Heights, Brooklyn, N. Y., has announced the opening of its Western factory at 1965 West Pershing road, Chicago. Armored conductors, armored lamp cord and flexible steel conduit will be manufactured at this plant. The above products, also nonmetallic flexible conduit, gas tubing and "Tri-cord" will be manufactured at the Brooklyn factory as heretofore.

Dayton-Dowd Co., Quincy, Ill., manufacturer of centrifugal pumps, has announced the opening of a new district office for the sale of its pumping machinery in the Pioneer building, St. Paul, Minn., in charge of George M. Kenyon Co. The firm consists of George M. Kenyon, president and general manager; Robert D. Lewis, vice-president, and James C. Willson, vice-president, all of whom are engineers of long standing in St. Paul and are well acquainted with the power-plant, railroad and municipal field.

Mica Insulator Co., 68 Church street, New York City, has announced that it has recently won a suit it brought last year against the Mica & Micanite Supplies Corp. for infringement of its registered trade mark "Micanite," which it has used for 28 yrs. to identify its built-up mica insulation, and for unfair competition because of the use of that trade mark as a part of the corporate name of the Mica & Micanite Supplies Corp. Judge Knox, of the District Court of the United States for the Southern District of New York, after a trial before him recently, entered a decree sustaining the position of the Mica Insulator Co. in all respects.

Standard Underground Cable Co., Pittsburgh, will, it is reported, build large works in St. Louis during the coming year for the manufacture of electric wire and cable used in the company's installations. The estimated cost of the plant is $2,500,000.

Terry Steam Turbine Co., Hartford, Conn., at a recent meeting elected the following officers: President, D. H. Thomson; vice-president and general manager, N. L. Snow; directors, E. B. Bennett, D. H. Thomson, J. L. Thomson, Frank E. Howard, N. D. Prince and Shiras Morris.

Pawling & Harnischfeger Co., Milwaukee, has issued bulletin 6X descriptive of the latest addition to its excavating machinery line—the P. & H. excavator-crane No. 206. The equipment is a full revolving, all-corduroy portable crane and excavator, constructed of unusually good material, the manufacturer states.

Brady Electric & Manufacturing Co., New Britain, Conn., has issued bulletins Nos. 19 and 21, pertaining to and illustrative of bracket hardware and wiring devices, mast-arms, arc-lamp cutouts, fuse boxes, etc., which the Brady concern makes. The company states that it has recently added to its line of mast-arms, etc., which it has manufactured for years, a line of bracket hardware and wiring devices.

Wheeler Condenser & Engineering Co., Carteret, N. J., has announced the publication of the 1921 edition of its "Steam Tables for Condenser Work." This is the sixth edition of a work which for many years has been widely used by engineers dealing with the condensation or evaporation of steam. The tables are in a very handy book form, pocket size. The properties of saturated steam are tabulated from 29.8 in. vacuum to atmospheric pressure in increments of tenths of an inch referred to a 30 in. barometer. The values were especially calculated for this book by Professor Marks. As it is customary in vacuum work to read vacuum in inches of mercury, this is superior to the old method of giving absolute pressures in pounds per square inch. Above atmospheric pressure the increments are in pounds gage. The book explains how measurements are made by means of the mercury column and barometer, and gives constants and tables for making corrections. Corrections for the thermal expansion of mercury, for the relative expansion of mercury and brass scale, and other corrections are included.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

ISIDORE FEIBLEMAN, Indianapolis, has been appointed Indiana representative of the Wisconsin Iron & Wire Works, of Milwaukee.

JOHN M. HARTMAN has resigned from the Aluminum Co. of America, Pittsburgh, to join the engineering staff of the Kewanee Boiler Co., Kewanee, Ill.

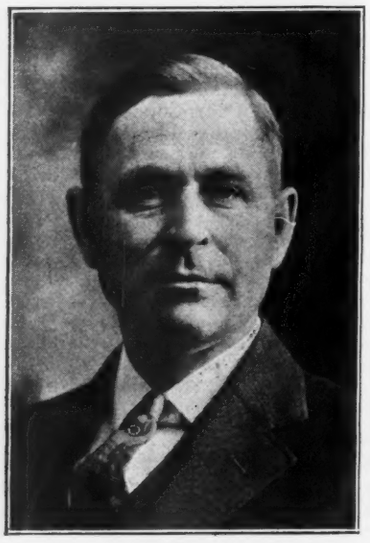
CHARLES A. KOTHE has been appointed mechanical superintendent of the American Automatic Connector Co., Cleveland, to succeed N. M. Barker, who recently resigned.

C. E. DAVIES has been appointed managing editor of *Mechanical Engineering*, published by the American Society of Mechanical Engineers, to succeed the late L. G. French.

JOHN CRAWFORD, formerly with the Wellman-Seaver-Morgan Co., Cleveland, has become designing engineer in the tank, tractor and trailer division of the Ordnance Department, U. S. A., to be located in Cleveland.

LEWIS A. MCARTHUR, general manager of the Pacific Power & Light Co. and vice-president of the Northwest Gas & Electric Equipment Co., Portland, Ore., recently had conferred upon him by the University of Oregon, the degree of Master of Arts in Public Service in recognition of his contributions to the development of the state.

N. G. SYMONDS, manager of the industrial division of the Chicago office of the Westinghouse Electric & Manufacturing Co., has been appointed manager of the Chicago office, succeeding T. Julian McGill. The territory under the jurisdiction of this office includes North Dakota, Minnesota, Wisconsin, Iowa and parts of Nebraska, South Dakota, Illinois, Indiana and Michigan. Mr. Symonds will become a veteran employe of 20 yrs. service with the Westinghouse interests Jan. 1, 1922. Graduating from the Leland Stanford University of California in 1901 as an electrical engineer, his first position was with a mining company in the Northwest. A short time later he joined the organization of the Westinghouse, Church, Kerr Co. of New York City, in the stoker-erecting department. In January, 1903, Mr. Symonds was made district superintendent of stoker erection, which position he held for 2 yrs. When the Westinghouse Machine Co. became engaged in the manufacture of stokers, Mr. Symonds went to East Pittsburgh, Pa., as assistant engineer of its stoker department. In May, 1905, he was made stoker salesman for the Chicago office of the Westinghouse company. About 1915, when the Westinghouse Machine Co. was absorbed by the Westinghouse Electric & Manufacturing Co. Mr. Symonds was made manager of the power department. In 1918 he was appointed manager of the industrial division of the Chicago office, which position he has held until the new appointment. Mr. Symonds is a member of the American Society of Mechanical Engineers, Electric Club of Chicago, University Club of Pittsburgh, Hinsdale Golf Club and the Hinsdale Club. He is also president of the local alumni of the Stanford University. Last year, his son, H. G. Symonds, won a Westinghouse War Memorial Scholarship and selected the Leland Stanford University of California, for his studies.



N. G. Symonds.

L. A. DAVIS, who was recently appointed manager of the telephone distributing house of the Western Electric Co. at Dallas, Tex., was transferred to the St. Louis house from the Missouri and Kansas Telephone organization in 1917. He became assistant stores manager in 1918 and stores manager at Dallas, Jan. 1, 1919.

E. F. LEARNED has been appointed sales agent for the C. W. Hunt Engineering Corp., with offices at 141 Milk street, Boston. The corporation handles the products of the C. W. Hunt Co., Inc., West New Brighton, N. Y., manufacturer of industrial electric locomotives, machinery, etc.

T. JULIAN MCGILL, manager of the Chicago office of the Westinghouse Electric & Manufacturing Co., has resigned to become vice-president of the Twin City Rapid Transit Co. of Minneapolis and St. Paul, in charge of operation and public policy. Mr. McGill has been with the Westinghouse Electric & Manufacturing Co. since 1898, the preceding 4 yrs. being spent with Augustine W. Wright, at that time vice-president and later president of the Siemens & Halske Co. of America. His first work with the Westinghouse company, after a course through the shop, was as salesman in Minneapolis. In 1903 Mr. McGill was made manager of the Minneapolis office, which comprised a territory at that time which contained a very few people per square mile. An instance of the condition of the territory at that time is that a 150-kw. alternator was installed in Calgary, Canada, to furnish all the commercial and street lighting energy for the town. With Professor C. F. Scott of Yale, Mr. McGill installed the 70,000 volt Canyon Ferry Butte transmission line, which in those days was the highest transmission voltage in use in the United States. In 1909 he was moved to the Atlanta, (Ga.) office as manager, where he remained until 1914, when he was appointed to the managership of the Chicago office. Mr. McGill is a member of the Veteran Employes Association of the Westinghouse company, with a 23-yr. continuous service record.

T. J. McGill.

OBITUARY.

GIRARD B. HARRIS, Plainfield, N. J., until recently treasurer of the Harris-McIntosh Battery Co., New York, City, died June 16, aged 34 yrs.

WILL H. BLOSS, manager of steam railroad sales of the Ohio Brass Co., Mansfield, O., died suddenly June 22 at his home in that city. He was born April 4, 1869, and received his engineering training at the Indiana University. Mr. Bloss started his career in railroad work and at one time was division engineer on the Santa Fe railroad, later holding a position as chief engineer of the Indiana Union Traction Co. He went with the Ohio Brass Co. Nov. 16, 1906, from the Buda Co., of Chicago, and was district sales manager in some of the central states until about a year ago. From that time he had devoted his efforts to electrification development and other steam-railroad problems.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Lewiston, Me. — A. R. Gould, Presque Isle, and associates, are perfecting plans for the construction of an electric railway line extending through the northern part of Maine, from a point connecting with the line of the Aroostock Valley Railway, Washburn, to Frontier lake, Quebec, about 110 mi. It is proposed to use the line primarily for lumber and industrial service.

Rutland, Vt.—The Howe Scale Co. is making extensive improvements in the electric power installation at its plant, to utilize central station service from the lines of the Rutland Railway, Light & Power Co. The electric company also has similar work under way on its installation at the Howe works.

Springfield, Vt. — The Vermont Hydro-Electric Corp. has increased the line voltage of its power line from Castleton, Vt., to the Castleton Corners substation, a distance of about 2.5 mi. from 13,000 to 44,000 volts. New transformers have been installed at the substation. The increased power will be used for service to two large slate grinding plants in this section. The company is completing the change in the load on its system at different points from 25 cycle to 60 cycle. One of the generators at the Mendon substation will be discontinued at an early date.

Boston, Mass.—Considerable electrical and mechanical equipment will be installed in the new 12-story hotel to be erected at the junction of Arlington and Providence street, estimated to cost $10,000,000. Plans are being prepared by Desmond & Lord, Boston, architects. A new company, to be known as the Bostonian, Inc., will build and operate the property. Charles S. Averill, Bancroft hotel, Worcester, Mass., is interested in the new company.

Newburyport, Mass.—The Hannah Shoe Co., Pleasant street, will install electric motors and other electrical equipment in its new plant extension, estimated to cost $100,000. Central station power will be used. W. D. Hannah is president.

Westfield, Mass. — Fire recently damaged the building of the Westfield Power Co., occupied by a number of industrial interests, with loss estimated at $25,000.

Worcester, Mass.—The New England Power Co., Harvard street, has arranged for a bond issue of $1,000,000, the proceeds to be used in connection with its proposed new hydroelectric power plant on the Deerfield river, near Searsburg, Vt. Contract has been let to the Alberthaw Construction Co., 27 School street, Boston, Mass., for the building erection, including foundations, earth dam and penstock. The entire generating plant is estimated to cost $225,000.

Meriden, Conn.—Electrical equipment will be installed in the 2-story addition to be erected at the paper box manufacturing plant of C. E. Schunack, 24 Randolph avenue.

Binghamton, N. Y.—The Binghamton Light, Heat & Power Co., is considering an extension to its transmission lines to Maine, East Union, Whitney Point and other sections in this locality, a total distance of 27 mi. At Marathon it is proposed to sell wholesale power to the local officials, for the operation of the local municipal electric plant.

Brooklyn, N. Y.—Considerable electrical equipment will be installed at the proposed new terminal plant of the Ashland Contracting Co. at Jamaica, L. I., comprising a site on Fulton street, between New York avenue and Paulins street, recently acquired. The entire project is estimated to cost $1,500,000.

Dundee, N. Y.—The Public Service Commission has granted authority to Evelyn H. Bailey, operating the Dundee electric light plant, to build a transmission line within the town of Milo, Yates county, N. Y., and exercise the franchise granted by the town.

Herkimer, N. Y.—The Municipal Commission contemplates building and operating an extension of the village lighting system under authority granted by the town board.

Lancaster, N. Y.—The Depew & Lancaster Light, Power & Conduit Co., Lancaster, Erie county, N. Y., has made application to the Public Service Commission for approval of a franchise granted by the Manilla township to distribute electricity for light, heat and power.

Mount Morris, N. Y.—The Mount Morris Illuminating Co. will extend its system to Geneseo, to furnish electric service at this location.

New York, N. Y.—The Brooklyn Rapid Transit Co. has been granted permission by the Transit Commission to issue receiver's certificates in the amount of $3,000,000, the proceeds to be used for equipment, operations, etc. Lindley M. Garrison is receiver.

New York, N. Y.—Electrical equipment will be installed in the 3-story plant addition to be erected by the Sinclair & Valentine Co., 611 West 129th street, manufacturer of lithographing inks, etc. The building contract has been awarded to the Vought Construction Co., 133 East 44th street.

New York, N. Y.—The Sodemann Heat & Power Co., a Missouri corporation, has filed notice of organization to operate in New York. I. R. Bissell, Buffalo, is corporate representative.

New York, N. Y.—The New York Edison Co., 130 East 15th street, has filed plans for the erection of a 1-story substation, 24 by 60 ft., at 38 Bowery, to cost about $130,000. W. Whitehall, 12 Elm street, is architect.

Niagara Falls, N. Y.—The Niagara Falls Gas & Electric Co. is negotiating with the city for the purchase of its local power plant, which, it is claimed, is not a profitable investment. The proposed plans cover the operation of the plant as municipal property.

Rochester, N. Y.—The Rochester Gas & Electric Corp is planning extensions and improvements in its plant and system to cost about $1,500,000. The work will include an extension to the power station, with new equipment, and the construction of a new transmission line from Rochester to Canandaigua. This latter is estimated to cost $600,000. The company is arranging for a bond issue in the amount noted to carry out the work.

Silver Creek, N. Y.—The Public Service Commission has granted permission to the Silver Creek Electric Co. to build a transmission and distributing system to extend to Forestville, Chautauqua county, for furnishing power service at this point.

Solvay, N. Y.—The New York Central Railroad Co., Grand Central Terminal, New York, will build a powerhouse in connection with other work at its locomotive repair plant at Solvay. George W. Kittredge, company address, is engineer for the project.

Dover, N. J.—The New Jersey Power & Light Co. is planning the installation of a number of new street lamps at Mt. Arlington.

Florence, N. J.—Electric motors and other electrical equipment will be installed in the machine shop to be erected by the Florence Pipe Foundry & Machine Co. Revised plans for the structure are being prepared, and bids for erection will be asked early in July. It will be 1-story, 60 by 250 ft.

Jersey City, N. J.—The Rogers Pyatt Shellac Co., 45-47 Essex street, has filed plans for the erection of a 1-story powerhouse addition at its works.

Newark, N. J.—Considerable electrical equipment will be installed in the new plant to be erected at Wright street and New Jersey Railroad avenue by the New York Pie Baking Co., 82 Sullivan street, New York, estimated to cost $125,000.

Trenton, N. J.—The Stacy-Trent Hotel Co., now building a new hotel on West State street, is arranging for the installation of lighting fixtures and equipment at an early date, estimated to cost $10,000.

Altoona, Pa.—The Altoona School District, Sixth avenue, has awarded a contract for the erection of its pro-

posed power plant on Sixth avenue, to J. C. Orr & Sons, Seventh avenue, at $70,472. Equipment contracts include: Turbines, General Electric Co., Philadelphia; boilers, Babcock & Wilcox Co., New York City; stokers, Combustion Engineering Corp., New York City, and coal and ash-handling plant. Dravo-Doyle Co., Pittsburgh.

Charleroi, Pa.—The Chamber of Commerce is promoting a project for the installation of a new "white way" street lighting system in the business district. Property owners will defray part of the cost.

Easton, Pa.—Organization of the Pennsylvania Edison Co. has been perfected and the Public Service Commission has been petitioned to approve the organization and operation. It will take over the properties of the Pennsylvania Utilities Co., and will operate in conjunction with the Metropolitan Edison Co., Reading, Pa., and the General Gas & Electric Co. The new company will be under the management of W. S. Barstow & Co., 50 Pine street, New York City.

Northampton, Pa.—A bondholders' protective committee, headed by C. S. Newhall, chairman, has acquired the property of the Northampton Traction Co., for a consideration of $430,000, including traction line, power plants, etc. The property will be operated, and extensions are planned.

Pittsburgh, Pa.—Electrical equipment will be installed in the 3-story plant addition, 45 by 100 ft., to be erected by the Danovitz Brothers Cooperage Co., 824 Carpenter street.

Pittsburgh, Pa.—Electrical equipment will be installed in the ice-manufacturing plant to be erected at 1218 West Carson street, Northside, by the North Pole Ice Co., estimated to cost $60,000.

Pittsburgh, Pa.—The Oliver Iron & Steel Co., Tenth and Muriel streets, has awarded a contract to D. T. Riffle, 1006 Forbes street, for the erection of a power house at its plant to cost about $40,000. Electrical equipment will also be installed in the 4-story building to be erected at the main plant, 60 by 120 ft., estimated to cost $125,000.

Scranton, Pa.—The Scranton Electric Co. has made application to the Public Service Commission for permission to increase its rate for power for electric railway lines now being supplied in this section from 12 mills, net, to 14 mills, net, per kw-hr.

Shippensburg, Pa.—The Chambersburg & Shippensburg Electric Railway Co. is planning an extension to its system to the line of the Western Maryland Railway Co.

York, Pa.—A new group of electric power companies is being organized and application for permission to operate has been made to the Public Service Commission. These include the Hopewell township, Shrewsbury township, Loganville, North Cadorus township, Jefferson, Codorus township, Seven Valley and New Salem Light and power companies.

Baltimore, Md.—Electric motors and other electrical equipment will be installed in the 2-story printing plant to be erected by the Monumental Printing Co., 522 East street, estimated to cost $65,000.

Baltimore, Md.—The Public Improvement Commission has ordered the project for the installation of equipment at the different powerhouses for the local public schools, estimated to cost $60,000 to be held in abeyance, pending arrangement for appropriations for other necessary municipal work.

Baltimore, Md.—Electrical and mechanical equipment will be installed at the coal mining plant of the Davis Coal & Coke Co., Continental building, at Thomas, W. Va. About $200,000 will be expended on plant extensions and improvements. A. W. Galloway is president.

Washington, D. C.—The District Commissioners have arranged for the installation of new equipment and improvements at the Bryant street pumping station for the waterworks system.

Washington, D. C.—C. B. Hawley, 450 Munsey building, has applied to the Federal Power Commission for a preliminary permit to construct diversion dam, conduit and powerhouse on New river at Sandstone Falls in Raleigh and Summers counties, West Virginia, for public utility purposes.

Norfolk, Va.—Electrical equipment will be installed at the new filter plant to be constructed by the Board of Works at 37th street and Parker avenue, estimated to cost $600,000. Charles M. Ashburn is city manager.

Norfolk, Va.—The U. S. Shipping Board, Washington, D. C., is planning the erection of a large electric power plant at Crande Island, near Norfolk, to be used in connection with the new fuel-oil station and storage plant to be erected at this location. An electrically operated pumping plant will also be constructed.

Richmond, Va.—The Roanoke River Development Co., Mutual building, has received permission from the Federal Power Commission for the erection of a new hydroelectric generating plant on the Roanoke river, near Boydton, Va. The proposed station will have an initial capacity of about 50,000 hp.

Virginia Beach, Va.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded a contract to the Newport Construction & Engineering Co, Newport News, Va., for the erection of a new radio building and tower at Virginia Beach, to cost $30,731.

Greenwood, S. C.—The Greenwood Water & Light Co. is arranging for the installation of 200 new street lamps in various parts of the city. New regulators, transformers and other equipment will be installed at the local power station.

Fort Meade, Fla.—J. G. Fancy and associates are organizing a company to erect a new electric generating plant at Wanchula, Fla., for light and power service in this section. The company will also construct an ice and cold storage plant. The total installation is estimated to cost $200,000.

Lakeland, Fla.—Considerable electrical equipment will be installed in the proposed ice-manufacturing plant to be erected here by the American Fruit Growers' Association, estimated to cost $300,000 with machinery.

NORTH CENTRAL STATES.

Ottawa, O.—The Northwestern-Ohio Light Co. has received permission of the county commissioners to construct a high-tension line from the Leipsic light plant to Ottawa. The company expects to have the line up by September.

Lansing, Mich.—The bonding issues of $1,650,000 for the erection of a new city and power plant were approved by the council and will be submitted to the people at a special election.

Powers, Mich.—The Powers-Spalding Light & Power Co. is a local incorporation which was organized June 10, by a dozen local men at the office of the Lirts State Bank. The company is capitalized at $25,000 and the stock has all been subscribed. The president of the company is W. H. Meedham.

Anderson, Ind.—The City Council recently appropriated $6000 for laying a new approach and for the installation of conduits and a lighting system and for the new cement bridge. The board concurred in W. E. Murchie's recommendation that twelve 60-watt lamps be kept lighted all night instead of placing 100-watt lamps, only four of which it was originally planned were to be lighted except on special occasions. He also suggested that the specifications be changed so that the bridge lamps be connected with the street lamp system.

Pekin, Ill.—The village of South Pekin will soon be furnished with electric light, energy for which will be supplied from Pekin.

Springfield, Ill.—The Springfield Chamber of Commerce at a recent meeting appointed a committee to confer with the city commissioners in regard to the restoration of the ornamental lighting system in South Fourth street.

Beloit, Wis.—Street lamps will be installed by the South Beloit commissioners July 18 in the Colley Hill addition in South Beloit, the section recently annexed to South Beloit, according to a decision reached at a commissioners meeting.

Pepin, Wis.—The Wisconsin-Minnesota Light & Power Co. will extend its line from Nelson to Pepin providing the citizens of Pepin advance a loan of from $15,000 to $17,000 to cover half the cost of construction.

St. Paul, Minn.—Bids were received June 27 for ornamental lamps on Summit avenue from Wabash street to Mississippi River boulevard. Address H. W. Austin, city purchasing agent.

Winterset, Ia.—Bonds to the amount of $100,000 have been authorized by vote to build a new electric light plant. Address city clerk.

Chillicothe, Mo.—The Board of Public Works, following the awarding of contracts for the electric light plant extension, has announced the work would be commenced as soon as possible and completed in the fall. The following selection and awards were made: The Ridgeway Dynamo & En-

gineering Co., one 625-Kw. turbo; Westinghouse Electric & Manufacturing Co., one switchboard, and the Worthington Pump & Machinery Corp., one Worthington jet condenser. William H. Miller was appointed for extension and repairs on the building.

Independence, Mo.—Citizens have approved a bond issue of $35,000 for the installation of a municipal electric power station. Address city clerk.

Lexington, Mo.—The Missouri Gas & Electric Service Co. has applied to the Missouri Public Service Commission for authority to construct a transmission line between Liberty and Lexington, passing through Missouri City, Orrick, Camden, Richmond and Henrietta.

New Haven, Mo.—The Common Council has awarded a contract to H. H. Washemeyer, Washington, Mo., for extensions and improvements in the municipal electric power plant, and to Fairbanks & Co., 620 Market street, St. Louis, for engines and other equipment. Fuller & Beard, Chemical building, St. Louis, are the engineers.

St. Louis, Mo.—Electrical equipment will be installed in the ice machine department to be constructed at the plant of the Sieloff Packing Co., 4339 Natural Bridge avenue, estimated to cost $25,000.

St. Louis, Mo.—The Dixie Power Co., Title Guaranty building, has applied to the Federal Power Commission for a preliminary permit to construct a high dam and powerhouse in the Buffalo river near its junction with Panther creek in Marion county, Arkansas, and probably a second dam and powerhouse to be located at the head of the pool created by the first dam, for public utility purposes.

Brookings, S. D.—Work will commence at an early date on an electric power and heating plant to be installed in Brookings in accordance with the result of a special election, when bonds of $60,000 were voted for the purpose. Address city clerk.

Bruce, S. D.—Bonds to the amount of $12,000 have been voted to install a 24-hr. electric lighting system. Address the mayor.

SOUTH CENTRAL STATES.

Mt. Sterling, Ky.—The Salt Lick Lumber Co. is planning the rebuilding of the powerhouse at its mills, destroyed by fire recently.

Stanton, Ky.—The Stanton Utilities Co. has been incorporated with a nominal capital of $10,000 to operate a local light and power system. Jesse Swangon heads the company.

Paris, Tenn.—The Common Council is arranging for a bond issue of $250,000 for extensions in the municipal electric lighting system and other city work.

Birmingham, Ala.—The Alabama Power Co. has arranged for a bond issue of $2,500,000, the proceeds to be used for extensions, general operations, financing, etc. Thomas W. Martin is president.

Fort Payne, Ala.—The local municipal power plant has been acquired by A. A. Miller, Chattanooga, Tenn. Extensive improvements will be made in the plant, including the installation of new equipment, and the plant will be operated for local service as a private enterprise.

Shelby, Miss.—The Shelby Light & Power Co. has been incorporated with a capital of $40,000, to operate a local light and power plant and system. Daniel Bradera and L. B. Wilkinson head the company.

Bryan, Okla.—The Common Council is planning a bond issue of $15,000 for the construction of a new power line from Kiowa, Kan., to the city lighting plant. The W. B. Rollins Engineering Co., Kansas City, Mo., is engineer.

Stillwater, Okla. — The Common Council has awarded a contract to the Ridgeway Engine Co., Ridgeway, Pa., for new equipment for installation at the municipal electric plant. J. W. McLendon is engineer for the city.

Tulsa, Okla.—Cosden & Co., operating a local oil refinery, will make extensions and improvements in the powerhouse at the plant to cost about $100,000.

Edgewood, Tex.—H. Jalonick and M. P. Ross of Dallas, representatives of the Texas Power & Light Co., met recently with 30 of the business men of this city and discussed with them the probability of immediately extending their high line from Terrell by the way of this place to Tyler. It is estimated that the total cost on completion will be $300,000.

Fairfield, Tex.—At a recent meeting of the Fairfield Business League a committee was appointed to take up the subject of securing electric lights for Fairfield.

Fredonia, Tex.—The Perry Telephone Co. has been organized with G. C. Perry, president; J. R. Perry, Jr., vice-president and manager. The company plans to erect a building and install equipment for a service station.

WESTERN STATES.

Kootenai Falls, Mont.—The Kootenai Power Construction Co., 347 Madison avenue, New York City, has applied to the Federal Power Commission for a preliminary permit to construct a dam and powerhouse at Kootenai Falls, Lincoln county, Montana; small power installation at the mouth of the Yaak river; transmission lines to pulp mill at confluence of the Yaak and Kootenai rivers, and a second mill near Kalispell, Flathead county, Montana, for pulp and paper mill purposes.

Bremerton, Wash.—An ordinance is before the council providing for installing an electric lighting system on Fifth street. Address the city clerk.

PROPOSALS.

Washington, D. C.—Sealed proposals will be opened July 8 for the installation complete of an electric dumb waiter in the U. S. Post Office at Lima, O., in accordance with the drawings and specifications, copies of which may be had at the office of James A. Wetmore, acting supervising architect, Washington, D. C.

Washington, D. C.—Sealed proposals will be opened July 11 for the installation complete of an electric passenger elevator in the infirmary of the U. S. Public Health Service Sanatorium at Dawson Springs, Ky., in accordance with the drawings and specification, copies of which may be had at the office of James A. Wetmore, acting supervising architect, Washington, D. C.

Havana, Ill.—Bids will be received by the Board of Commissioners of the Chautauqua Drainage and Levee District July 5 for: One 32 ft. by 35 ft. 6 in. steel frame cement stucco pump station building complete in place; one 50-hp., 40 deg. slip-ring electric motor, complete in place; one 100-hp., 40 deg. slip-ring electric motor, complete in place; one electric motor exhauster pump, complete in place, 800 linear ft. No. 2 submarine cable, complete in place; 0.5 mi. high-tension copper circuit transmission line, complete in place. Also miscellaneous electrical equipment, including switchboards, wattmeters, voltmeters, ammeters, lighting transformers, electric lighting motor controllers, etc, complete in place. Address E. B. Lesourd, commissioner; Lyman Lacey, Jr., attorney, Havana, Ill., or Goodell & Millard, engineers, Beardstown, Ill.

INCORPORATIONS

Baltimore, Md. — Graywyn, Inc., 220 North Holiday street. Capital, $10,000. To manufacture and deal in electrical equipment and appliances. Incorporators Jack Albert, Lee Silver and Joseph Silverman.

Brooklyn, N. Y.—Ace Battery Manufacturing Co. Capital, $10,000. To manufacture electrical storage batteries and kindred equipment. Incorporators: F. E. Ritter, L. P. Mendham and E. Klein, 44 Court street.

New York, N. Y.—Electrical Manufacturing Corp. Capital, $200,000. To manufacture electrical equipment. Incorporators: J. Behrens, A. L. Wyman and C. A. Levy, 34 Nassau street.

New York, N. Y.—The Worber Co., Inc. Capital, $20,000. To manufacture electrical appliances. Incorporators: J. S. and M. Worhaf, and S. Berger.

Canistee, N. Y.—Distributors Electric Co. Capital, $20,000. To manufacture electrical equipment. Incorporators: J. N. Anderson, H. and T. C. Cobb.

Newark, N. J.—Air Brake Engineering Co. Capital, $125,000. To manufacture air compressors, air brakes and kindred products. Incorporators: Edmund S. Ashworth, Oscar E. and Alfred S. Emerson, 20 Center street.

Elizabeth, N. J.—Con-Den-Rit Radiant Log Co. Capital, $100,000. To manufacture electric heating and lighting equipment. Incorporators: James P. Conroy, Orange, N. J.; Charles C. Denton and Albert F. Reithemeyer, Elizabeth.

Newark, N. J.—Baum Electric Co., 514 Orange street, has filed organization to operate an electrical contracting business. F. W. Baum heads the company.

Easton, Pa.—W. E. Groff Co. Capital, $25,000. To manufacture and deal in electrical products. Incorporators: W. E. Groff, John Stead, and Harvey Herstein.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Offering of Iowa Railway & Light Co. Gold Bonds.

The Iowa Railway & Light Co. has sold $1,000,000 first and refunding mortgage 5% gold bonds, paying 8%, to the Harris Trust and Savings Bank, Chicago. The bonds will carry two coupons—one paying 5% and the other 3%—making a total of 8%. They mature Sept. 1, 1932, and are being offered by the Harris Trust and Savings Bank at 100 and interest, yielding 8%. The Iowa Railway & Light Co. does a diversified utility business, 78% of which is electric light and power, steam heating and gas. The cities served are in the heart of the Iowa corn belt and include Cedar Rapids, Marshalltown and Iowa City. As officially reported for the year ended May 31, 1921, the gross earnings of the company were $3,104,055; net earnings, $819,676, or more than twice the annual interest charge ($390,950) on outstanding bonds, including this issue.

Western States Company Retires Bonds.

The Girard Trust Co., Philadelphia, trustee for the Western States Gas & Electric Co., first and refunding mortgage 5% gold bonds, due June 1, 1941, is advertising for tenders of the bonds at a price not exceeding par, accrued interest and 5% premium, to the amount of $122,724.16, now available in the sinking fund. Sealed tenders will be received until noon, July 6, 1921.

Increase Capital Stock of Illinois Bell Telephone Co.

Stockholders of the Illinois Bell Telephone Co. have ratified the resolution of the board of directors for increasing the capital stock from $40,000,000 to $50,000,000. The board of directors then passed a resolution to submit the matter to the State Utilities Commission for approval.

Virginia Railway & Power Co.

	1921.	1920.
April gross	$ 840,991	$ 780,363
Net earnings	255,775	248,878
Total income	266,706	261,662
Surplus after charges	78,751	69,753
4 mo. gross	3,419,192	3,111,072
Net earnings	1,038,785	1,026,909
Total income	1,081,636	1,073,150
Surplus after charges	313,105	324,463

Pacific Power & Light Co.

	1921.	1920.
April gross	$ 236,145	$ 209,446
Net after taxes	97,542	95,739
Total income	103,733	96,386
Surplus after charges	49,149	52,007
12 months gross	2,792,755	2,329,700
Net after taxes	1,267,246	1,098,066
Total income	1,325,780	1,107,420
Surplus after charges	706,094	574,311
Balance after preferred dividends	492,594	383,892

Havana Electric Railway, Light & Power Co.

For the year ended Dec. 31, 1920, the Havana Electric Railway, Light & Power Co. reports balance after charges and taxes of $3,502,595 as compared with $4,108,510 in the previous year. Income account for the year 1920 compares as follows:

	1920.	1919.
Gross	$11,477,937	$9,397,452
Net after taxes	5,029,485	4,417,767
Balance after charges	4,108,510	3,502,595
Dividends	2,155,609	2,155,613
Surplus	1,952,901	1,346,982

Duquesne Light Co. and Subsidiaries.

	1921.	1920.
April gross	$1,330,630	$1,154,366
Net after taxes	508,418	325,600
4 mo. gross	5,760,352	4,991,756
Net after taxes	2,096,688	1,714,498

Standard Gas & Electric Co.'s Subsidiaries.

The combined earnings of all Standard Gas & Electric Co.'s utility subsidiaries for the 12 mo. ended April 30, 1921, compared with earnings for the corresponding 12 mo., are reported as follows.

12 mo. ended April 30—	1921.	1920.
Gross revenue	$34,160,295	$28,639,169
Gross earnings*	32,539,662	27,316,140
Net earnings	11,543,802	10,650,005

*Does not include revenue collected for other producing companies.

Niagara, Lockport & Ontario Power Co.

Consolidated statement of Niagara, Lockport Ontario Power Co. and Niagara & Erie Power Co. for the year ended Dec. 31, 1920, shows sales of $2,899,547. Net after costs and expenses was $1,189,361, which with other income of $139,379 brought gross income up to $1,328,740. After providing for taxes, interest, depreciation and other charges, net income amounted to $170,157.

Northern Texas Electric Co.

	1921.	1920.
April gross	$ 301,549	$ 310,205
Net earnings	114,208	118,162
Surplus after charges	88,810	93,299
12 mo. gross	3,964,666	3,624,725
Net earnings	1,393,846	1,421,763
Surplus after charges	1,091,876	1,123,044

Puget Sound Power & Light Co.

	1921.	1920.
April gross	$ 850,217	$ 813,507
Net earnings	339,744	337,630
Surplus after charges	185,894	180,772
12 mo. gross	10,176,948	9,326,058
Net earnings	4,309,755	3,721,498
Surplus after charges	2,418,305	1,917,291

Galveston-Houston Electric Co.

	1921.	1920.
April gross	$ 298,842	$ 299,825
Net earnings	68,860	88,776
Surplus after charges	33,081	53,446
12 mo. gross	3,948,156	3,229,703
Net earnings	1,149,562	846,795
Surplus after charges	726,131	424,122

Manila Electric Railroad & Lighting Corp.

	1921.	1920.
April gross	$ 279,408	$ 254,072
Net after taxes	104,901	96,151
Total income	105,027	96,182
Surplus after charges	72,309	64,245
12 mo. gross	3,550,547	2,803,489
Net after taxes	1,334,283	784,155
Total income	1,335,516	786,781
Surplus after charges	874,749	432,015
Balance after preferred dividends	574,749	132,015

Blackstone Valley Gas & Electric Co.

	1921.	1920.
April gross	$ 282,045	$ 265,928
Net earnings	82,424	87,456
Surplus after charges	54,494	62,581
12 mo. gross	3,342,563	2,896,937
Net earnings	905,229	879,527
Surplus after charges	584,430	581,330

Metropolitan Edison Co.

	1921.	1920.
April gross	$ 216,955	$ 218,549
Net after taxes	83,368	65,665
12 mo. gross	2,825,237	2,385,390
Net after taxes	789,791	864,675

United Gas & Electric Corp. Subsidiaries.

	1921.	1920.
April gross	$1,020,999	$ 963,608
Net after taxes	328,903	302,396
Total income	352,002	329,281
Surplus after charges	131,459	122,636
12 mo. gross	12,372,738	10,930,339
Net after taxes	3,633,735	3,747,481
Total income	3,925,148	3,977,560

Dividends.

	Term.	Rate.	Payable.
All-America Cables	Q	1.75%	July 14
Bangor Ry. & El., pfd.	Q	1.75%	July 1
Columbia G. & El.	Q	$1.50	Aug. 15
Elmira Water, Lt. & Ry., 1st pfd.	Q	1.75%	June 30
Elmira Water, Lt. & Ry., pfd.	Q	1.25%	June 30
El Paso El., pfd.	SA	3 %	July 11
New England T. & T.	Q	$2	June 30
West Pa. Pr., pfd.	Q	1.75%	Aug. 1
Westghse. Air Brake	Q	$1.75	July 30

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiger & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid June 20.	Bid June 27.
Adirondack Electric Power of Glens Falls, common	6	9	9
Adirondack Electric Power of Glens Falls, preferred	6	74	70
American Gas & Electric of New York, common	..	102	98
American Gas & Electric of New York, preferred	6	37	36
American Light & Traction of New York, common	..	76	76
American Light & Traction of New York, preferred	6	80	78
American Power & Light of New York, common	4	54	53
American Power & Light of New York, preferred	6	64	64
American Public Utilities of Grand Rapids, common	..	7	7
American Public Utilities of Grand Rapids, preferred	7	17	17
American Telephone & Telegraph of New York	..	105	103
American Water Works & Elec. of New York, common	..	4	4
American Water Works & Elec. of New York, particip	7	8	8
American Water Works & Elec. of New York, 1st preferred	..	50	49
Appalachian Power, common	..	4	4
Appalachian Power, preferred	7	29	29
Cities Service of New York, common	+extra	130	130
Cities Service of New York, preferred	6	48	44
Commonwealth Edison of Chicago	8	107	107
Comm. Power, Railway & Light of Jackson, common	..	10	9
Comm. Power, Railway & Light of Jackson, preferred	6	29	28
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	41	41
Northern States Power of Chicago, common	..	47	46
Northern States Power of Chicago, preferred	ex.div.7	80	79
Pacific Gas & Electric of San Francisco, common	..	52	51
Public Service of Northern Illinois, Chicago, common	7	78	77
Public Service of Northern Illinois, Chicago, preferred	6	78	77
Standard Gas & Electric of Chicago, common	..	10	9½
Standard Gas & Electric of Chicago, preferred	8	33	33
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	5	4
Western Power of San Francisco, common	..	24	23
Western Union Telegraph of New York	..	90	90
Industrials—			
General Electric of Schenectady	8	123	127
Westinghouse Electric & Mfg. of Pittsburgh, common	7	43½	44